

US011460715B2

(12) **United States Patent**
Thorsell et al.

(10) **Patent No.:** **US 11,460,715 B2**
(45) **Date of Patent:** **Oct. 4, 2022**

(54) **EYEWEAR LENS INTERCHANGE WITH
MAGNETIC LATCH**

USPC 351/95, 99–100, 140
See application file for complete search history.

(71) Applicant: **Smith Sport Optics, Inc.**, Portland, OR
(US)

(56) **References Cited**

(72) Inventors: **Eric Thorsell**, Portland, OR (US);
Alberto Ventura, Portland, OR (US)

U.S. PATENT DOCUMENTS

(73) Assignee: **Smith Sport Optics, Inc.**, Portland, OR
(US)

1,660,587 A * 2/1928 Tully G02C 11/12
2/13
6,253,388 B1 7/2001 Lando
6,592,220 B1 7/2003 Cheong
6,679,604 B1 * 1/2004 Bove G02C 5/22
351/153

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 282 days.

7,175,276 B1 2/2007 Hsiung
7,192,135 B1 3/2007 Cheng
(Continued)

(21) Appl. No.: **16/802,309**

FOREIGN PATENT DOCUMENTS

(22) Filed: **Feb. 26, 2020**

EP 2607943 B1 5/2014
EP 2607944 B1 5/2014
(Continued)

(65) **Prior Publication Data**

US 2020/0278564 A1 Sep. 3, 2020

OTHER PUBLICATIONS

Related U.S. Application Data

Extended European Search Report received in EP App. No. 20159225.0
dated Jul. 23, 2020.

(60) Provisional application No. 62/812,139, filed on Feb.
28, 2019.

Primary Examiner — Zachary W Wilkes

(74) *Attorney, Agent, or Firm* — Dorsey & Whitney LLP

(51) **Int. Cl.**
G02C 5/22 (2006.01)
G02C 1/08 (2006.01)
G02C 5/14 (2006.01)

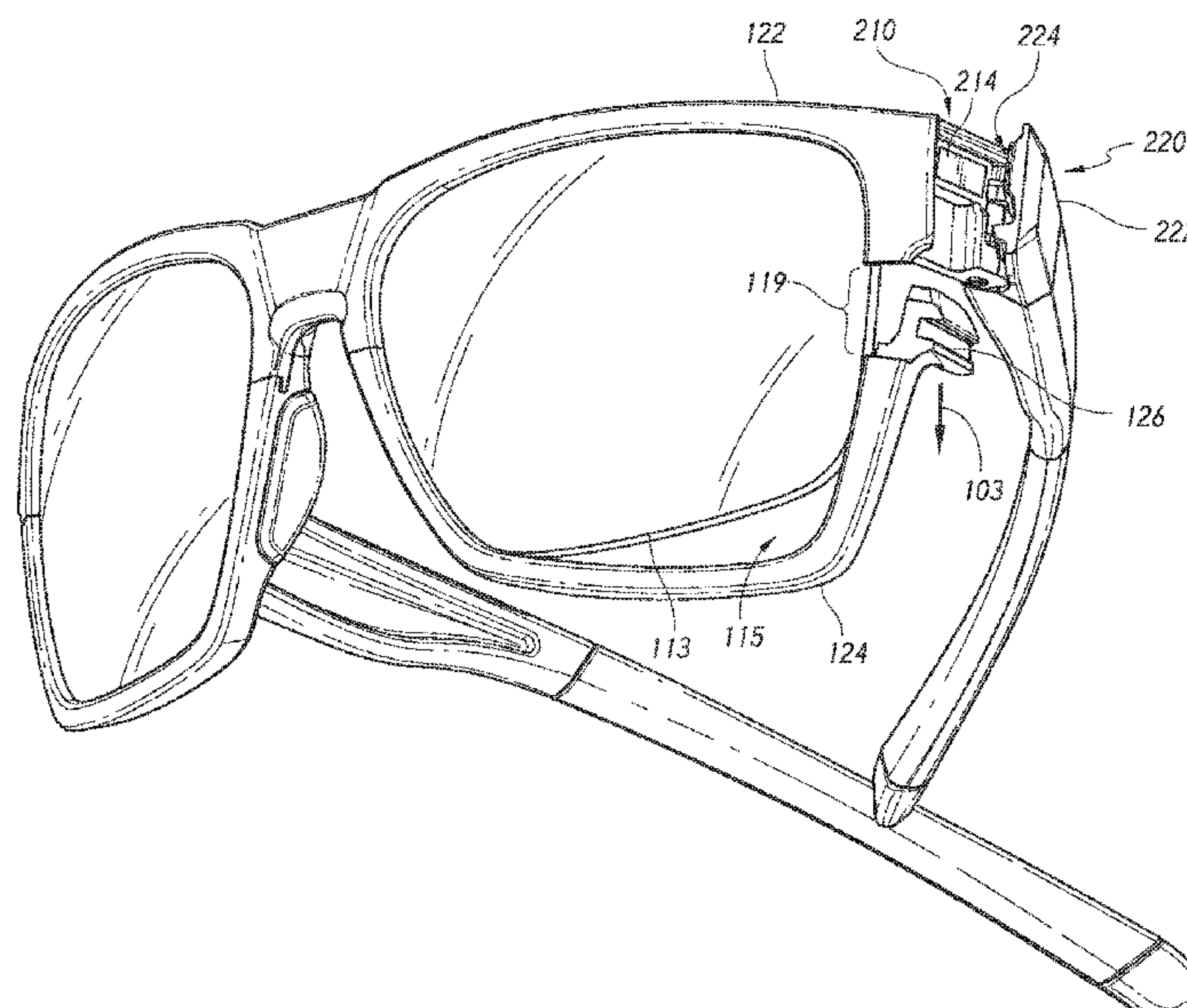
(57) **ABSTRACT**

(52) **U.S. Cl.**
CPC **G02C 5/22** (2013.01); **G02C 1/08**
(2013.01); **G02C 5/146** (2013.01); **G02C**
2200/02 (2013.01); **G02C 2200/06** (2013.01);
G02C 2200/08 (2013.01)

A lens interchange mechanism for an eyewear may include
a magnetic latch operatively associated with the eyewire of
the eyewear, such that the a portion of the eyewire can be
released, with a free end separating from another portion of
the eyewire thereby forming a gap in the eyewire for the
removal and installation of a lens. The magnetic latch
mechanism may be further configured for easy re-latching
by the application of opposing forces on the first and second
eyewire portions to cause the free end to re-engage with the
magnetic latch without manual actuation of the latch.

(58) **Field of Classification Search**
CPC . G02C 5/22; G02C 5/146; G02C 1/08; G02C
2200/02; G02C 2200/06; G02C 2200/08;
A61F 9/02–9/029

17 Claims, 16 Drawing Sheets



(56)

References Cited**U.S. PATENT DOCUMENTS**

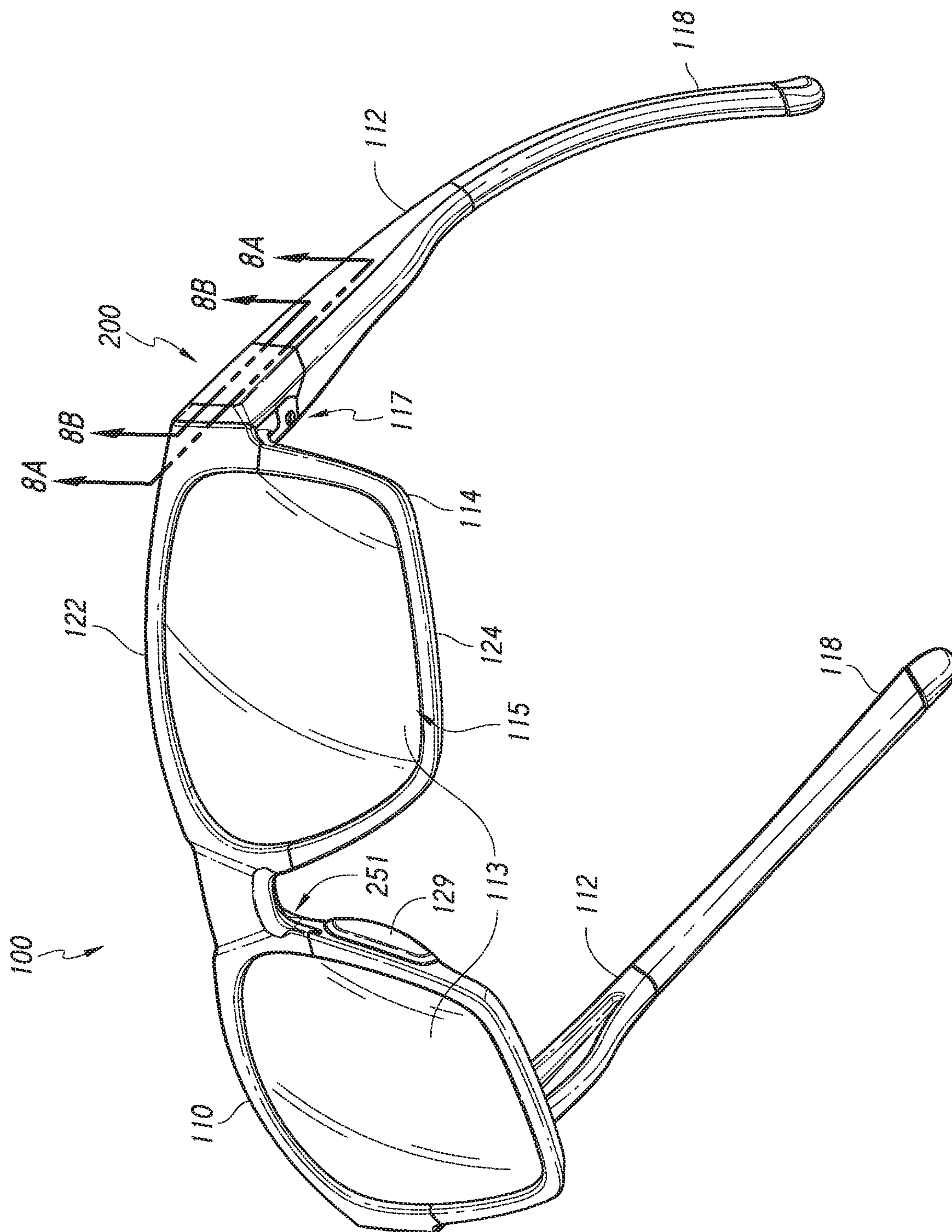
7,241,007 B2 7/2007 Cody et al.
 7,431,453 B2 10/2008 Hogan
 7,520,605 B1 4/2009 Chen
 7,556,373 B2 7/2009 Vanatta et al.
 7,645,040 B2 1/2010 Habermann
 7,712,895 B2 5/2010 Wang
 7,797,765 B2 9/2010 Musal et al.
 7,874,669 B2 1/2011 Moritz et al.
 7,931,366 B1 4/2011 Lando
 8,025,396 B1 9/2011 Power
 8,182,086 B2 5/2012 Cheong
 8,303,111 B2 11/2012 Lin
 8,322,849 B2 12/2012 Krumme et al.
 8,430,506 B2 4/2013 Chen
 8,480,226 B2 7/2013 Ifergan
 8,613,515 B2 12/2013 Earley
 8,641,188 B2 2/2014 DiChiara
 8,668,330 B2 3/2014 Reyes et al.
 8,702,232 B2 4/2014 Chen
 8,800,067 B2 8/2014 Saylor et al.
 8,827,443 B2 9/2014 Huynh
 8,832,904 B2 9/2014 Kidouchim
 8,905,539 B2 12/2014 Chen
 8,911,075 B2 12/2014 Chen
 8,911,076 B2 12/2014 Calilung et al.
 8,915,586 B2 12/2014 Porter
 8,960,896 B2 2/2015 Chou et al.
 8,992,007 B2 3/2015 Li
 9,004,679 B2 4/2015 Chen
 9,010,928 B2 4/2015 Fuchs et al.
 9,016,855 B2 4/2015 Chen
 9,081,211 B2 7/2015 Zelazowski
 9,081,213 B2 7/2015 Weinberg
 9,104,043 B2 8/2015 Crescenzi et al.
 9,122,078 B2 9/2015 Calilung et al.
 9,188,792 B2 11/2015 Calilung et al.
 9,192,519 B2 11/2015 Tobia
 9,207,464 B2 12/2015 Schmidt
 9,239,469 B2 1/2016 Zider et al.
 9,261,711 B1 2/2016 Chen
 9,279,999 B1 3/2016 Weng et al.
 9,345,622 B2 5/2016 McNeal et al.
 9,400,398 B2 7/2016 Darcy
 9,400,401 B2 7/2016 Darcy
 9,454,017 B2 9/2016 Chen
 9,588,355 B2 3/2017 Cohn
 9,606,372 B2 3/2017 Berdan
 9,632,330 B2 4/2017 Chilson et al.
 9,638,934 B2 5/2017 Kidouchim
 9,678,358 B2 6/2017 Lando
 9,678,359 B2 6/2017 Lipawsky
 9,690,114 B2 6/2017 Chen
 9,696,561 B2 7/2017 Lin
 9,709,818 B1 7/2017 Chen
 9,720,255 B2 8/2017 Park
 9,726,901 B2 8/2017 Porter
 9,740,021 B1 8/2017 Chen
 9,759,929 B2 9/2017 Rinehart
 9,778,483 B2 10/2017 Chen
 9,795,513 B2 10/2017 Padovani

9,804,420 B2 10/2017 Chute et al.
 9,829,719 B1 11/2017 Neren
 9,857,606 B2 1/2018 Chen
 9,895,266 B2 2/2018 Reynolds et al.
 9,943,444 B2 4/2018 Kilduff et al.
 9,964,779 B2 5/2018 Poole
 9,983,415 B2 5/2018 Mcginley et al.
 10,197,814 B2 * 2/2019 Thorsell G02C 1/08
 2013/0321757 A1 12/2013 Chen
 2014/0063439 A1 * 3/2014 Chen G02C 1/06
 351/96
 2014/0157496 A1 6/2014 Ginther et al.
 2014/0218677 A1 8/2014 Chen
 2015/0022774 A1 * 1/2015 Chen G02C 5/10
 351/57
 2016/0018670 A1 1/2016 Lando et al.
 2016/0103332 A1 4/2016 Lin
 2016/0116760 A1 * 4/2016 Chen G02C 5/22
 351/109
 2016/0216533 A1 7/2016 Calilung et al.
 2016/0231588 A1 8/2016 Serge
 2016/0287444 A1 10/2016 Han et al.
 2016/0299359 A1 10/2016 Ogawa et al.
 2016/0327810 A1 11/2016 Cross
 2016/0354249 A1 12/2016 Frank et al.
 2017/0045754 A1 2/2017 Rubaud et al.
 2017/0108708 A1 4/2017 Lin
 2017/0131563 A1 5/2017 Shiue
 2017/0143545 A1 5/2017 Zwolsman et al.
 2017/0219843 A1 8/2017 Albouy
 2017/0307903 A1 10/2017 Calilung et al.
 2017/0315382 A1 11/2017 Jones
 2017/0329153 A1 11/2017 Strenz
 2017/0357103 A1 12/2017 Jiang et al.
 2017/0357104 A1 * 12/2017 Chen G02C 5/146
 2018/0004008 A1 1/2018 Froissard
 2018/0129075 A1 5/2018 Zewe

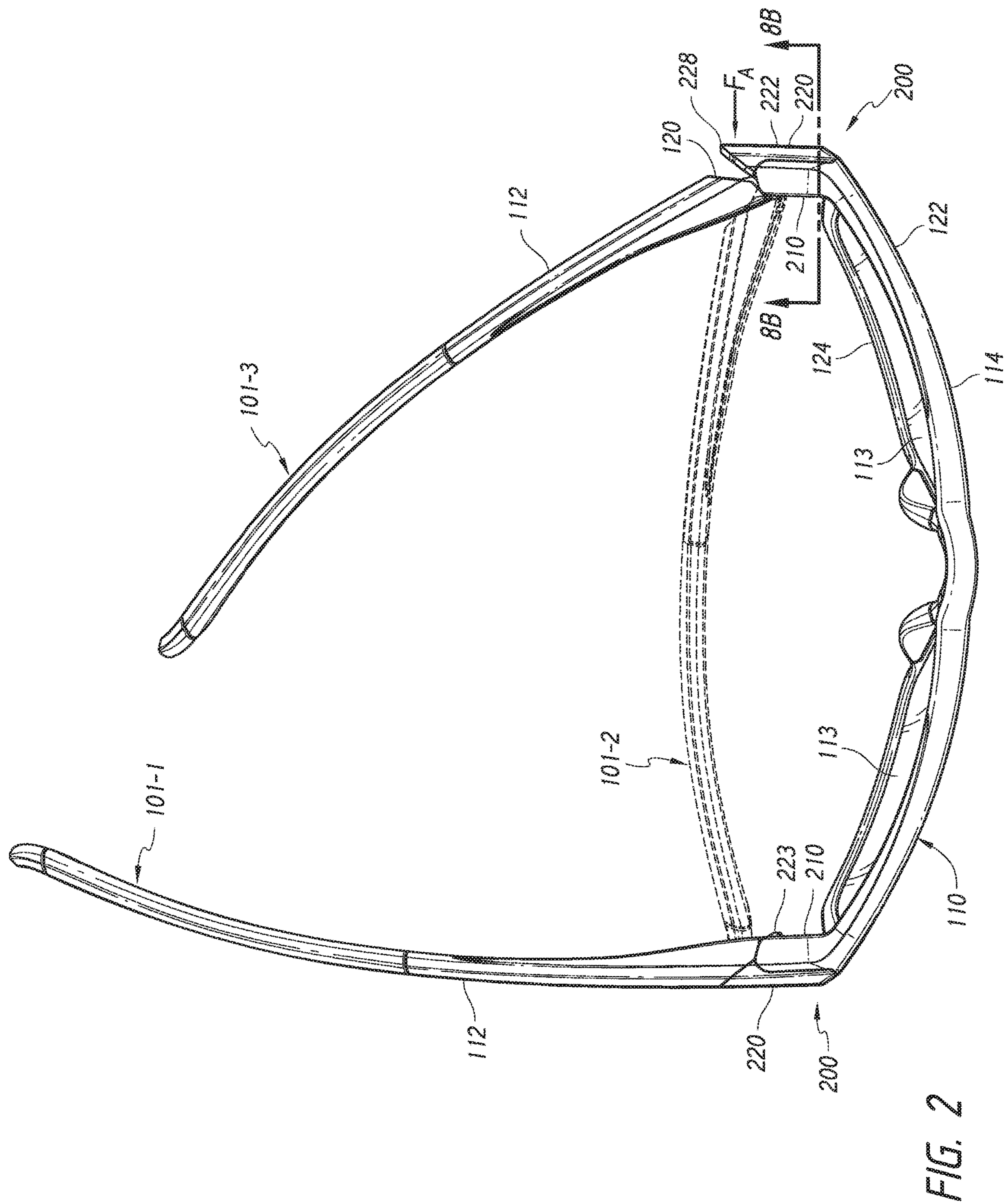
FOREIGN PATENT DOCUMENTS

EP 2767861 A1 8/2014
 EP 2674138 B1 11/2015
 EP 3021159 A1 5/2016
 EP 2723284 B1 3/2017
 EP 3167854 A1 5/2017
 EP 2304492 B1 9/2017
 EP 2758828 B1 4/2018
 EP 2893911 B1 6/2018
 EP 3370106 A1 9/2018
 WO 2009093279 A1 7/2009
 WO 2009103354 A1 8/2009
 WO 2009113187 A1 9/2009
 WO 2014111966 A1 7/2014
 WO 2015054799 A1 4/2015
 WO 2016070238 A1 5/2016
 WO 2016079767 A1 5/2016
 WO 2016124866 A1 8/2016
 WO 2017013522 A1 1/2017
 WO 2017162370 A1 9/2017
 WO 2017189130 A1 11/2017
 WO 2018007901 A1 1/2018
 WO 2018050188 A1 3/2018

* cited by examiner



154



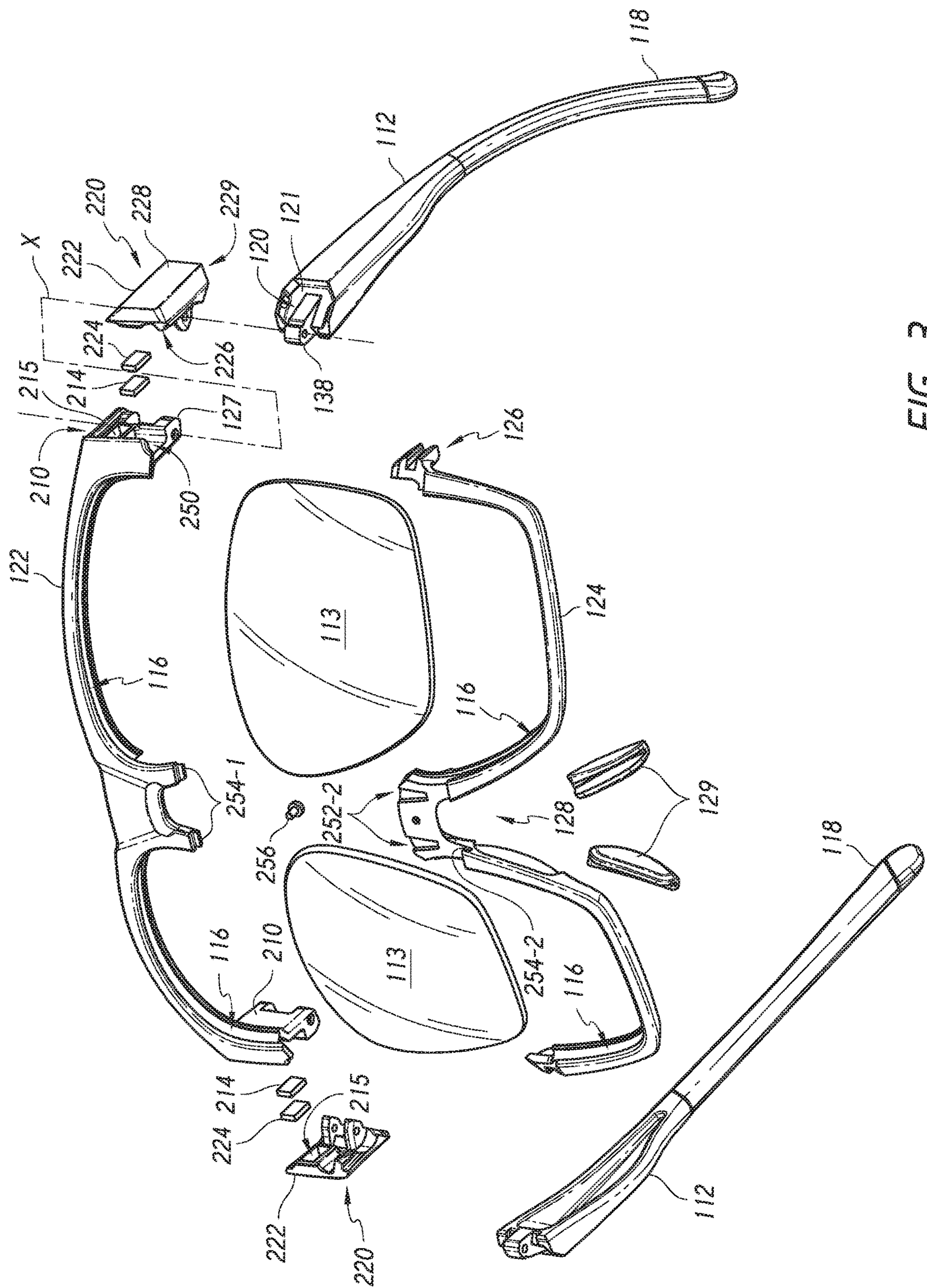
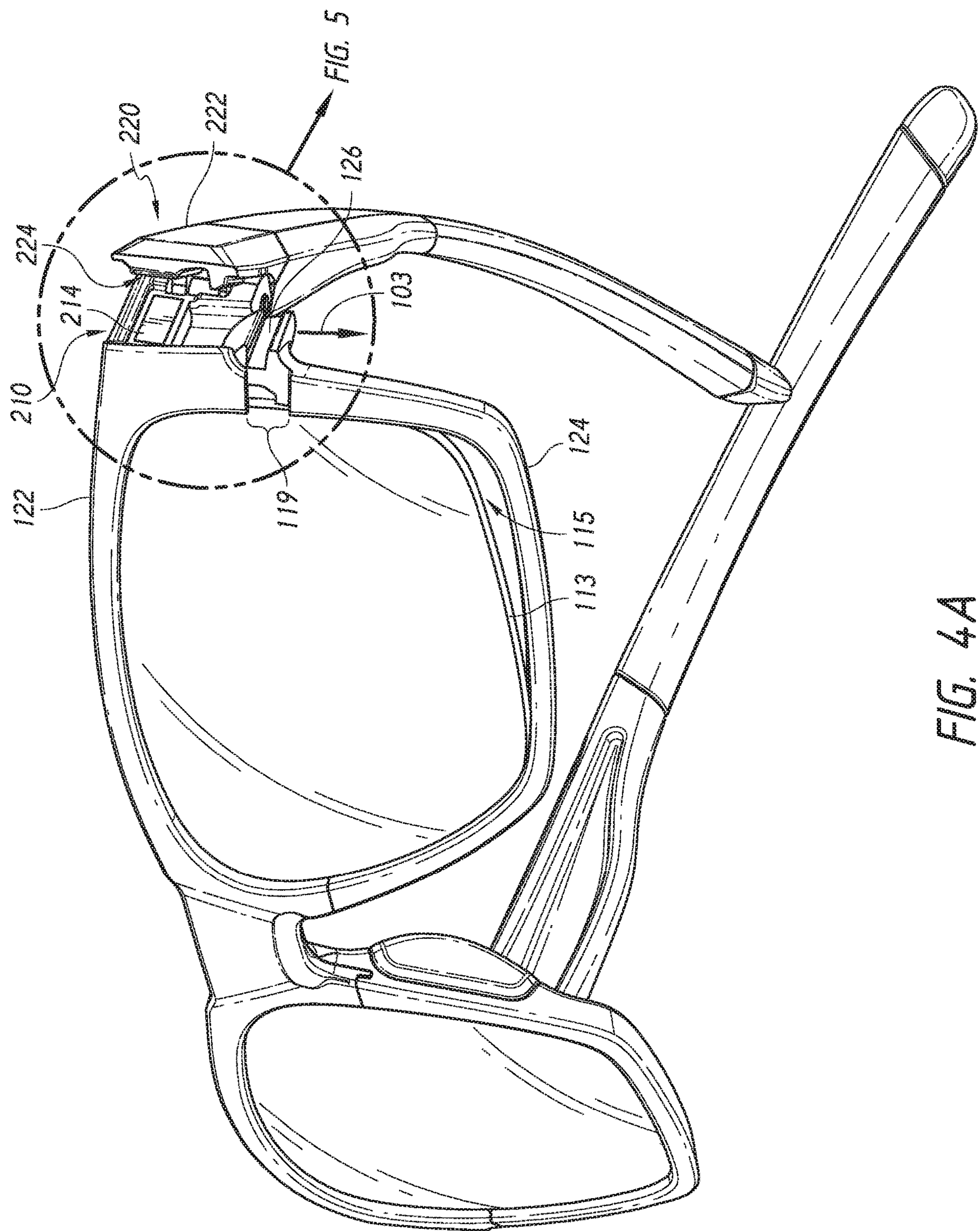


FIG. 3



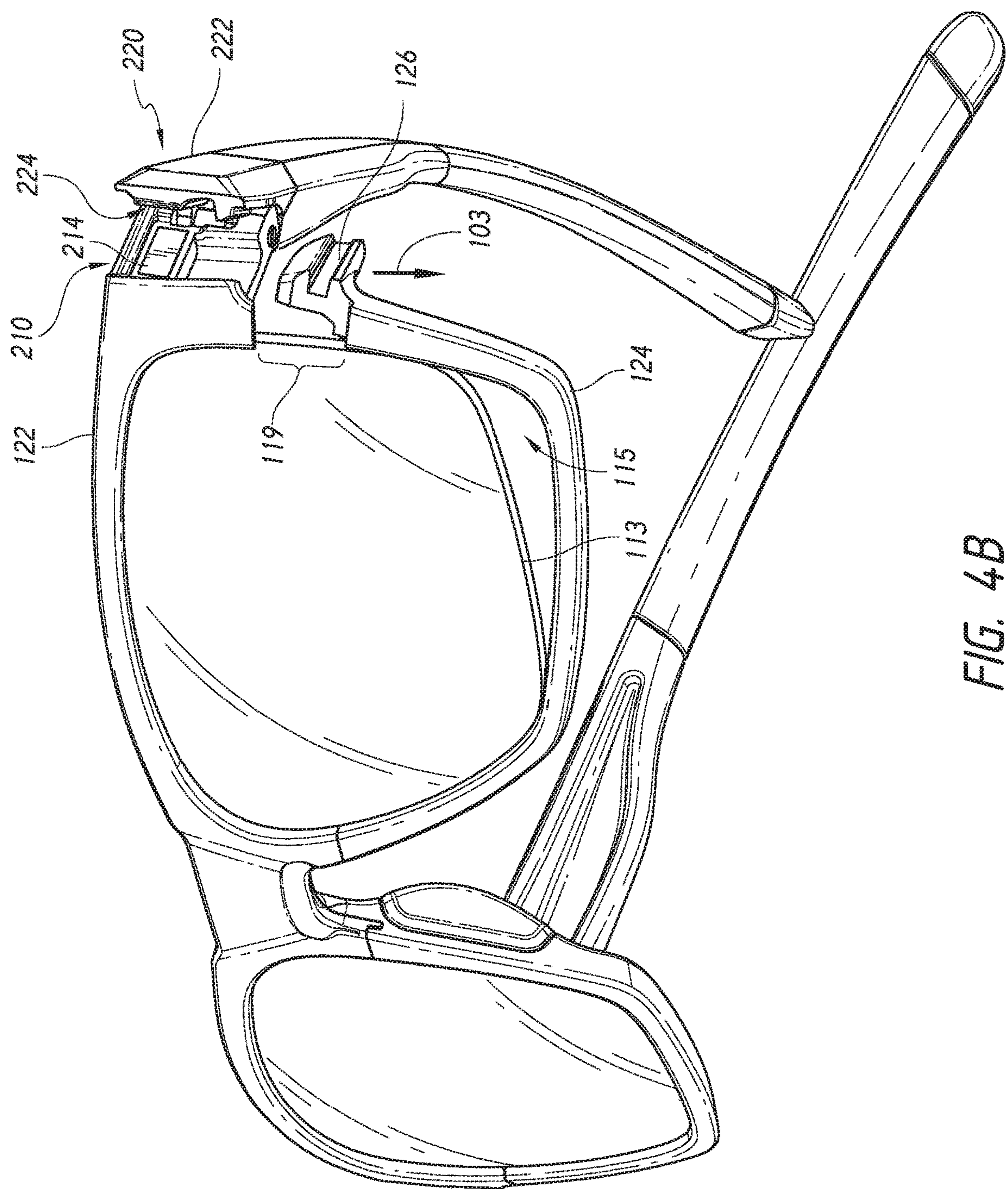


FIG. 4B

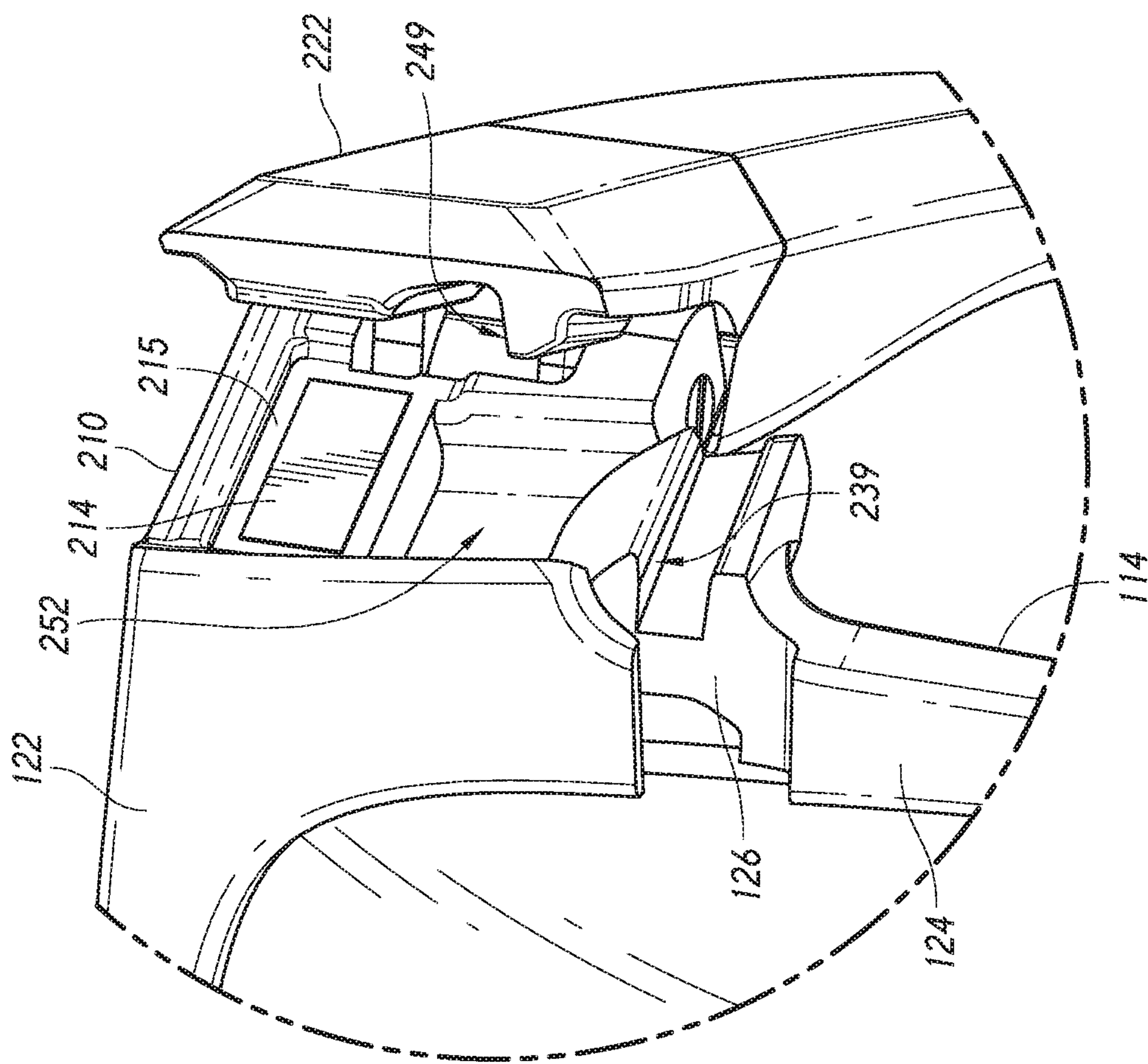


FIG. 5

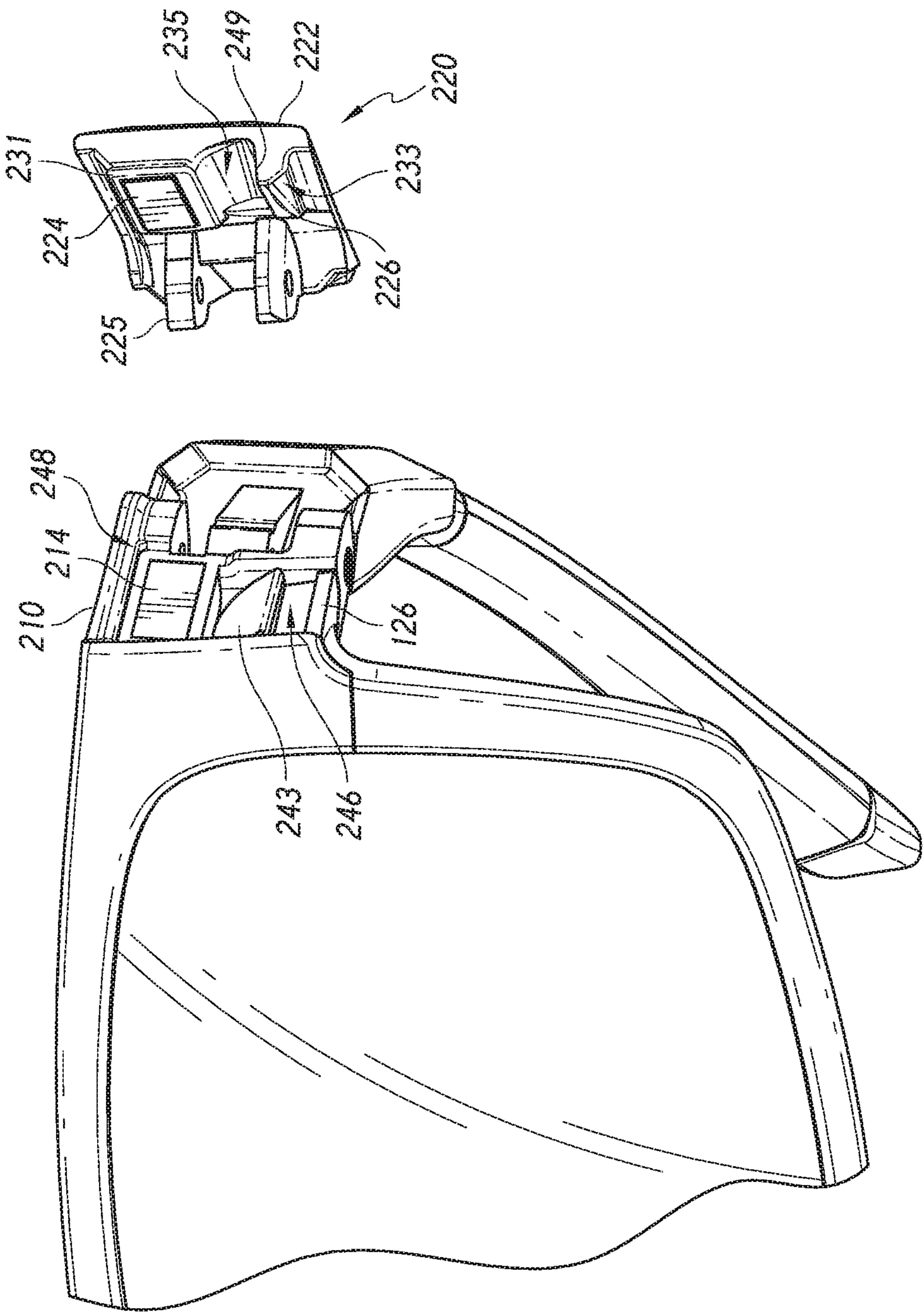
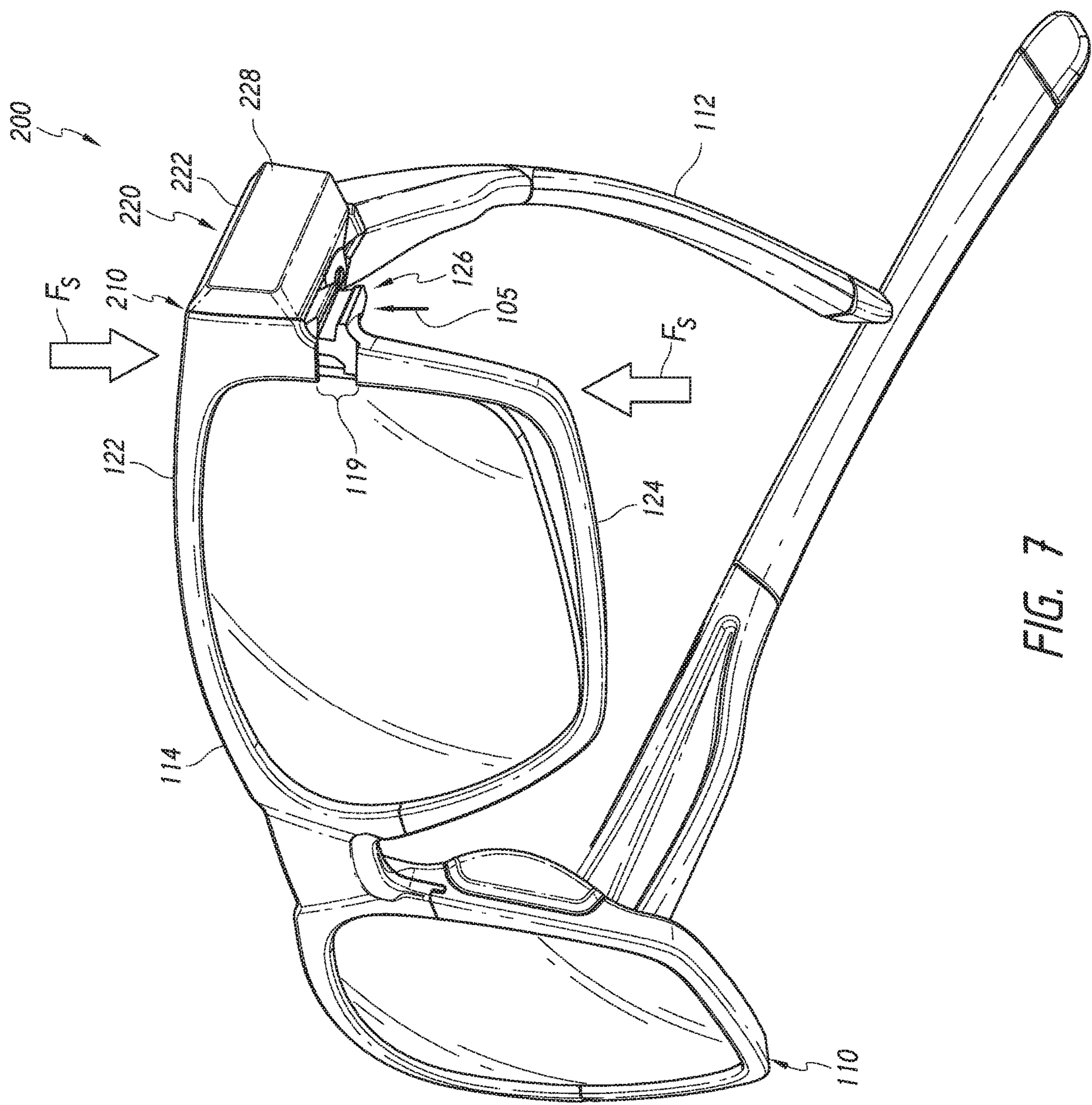


FIG. 6



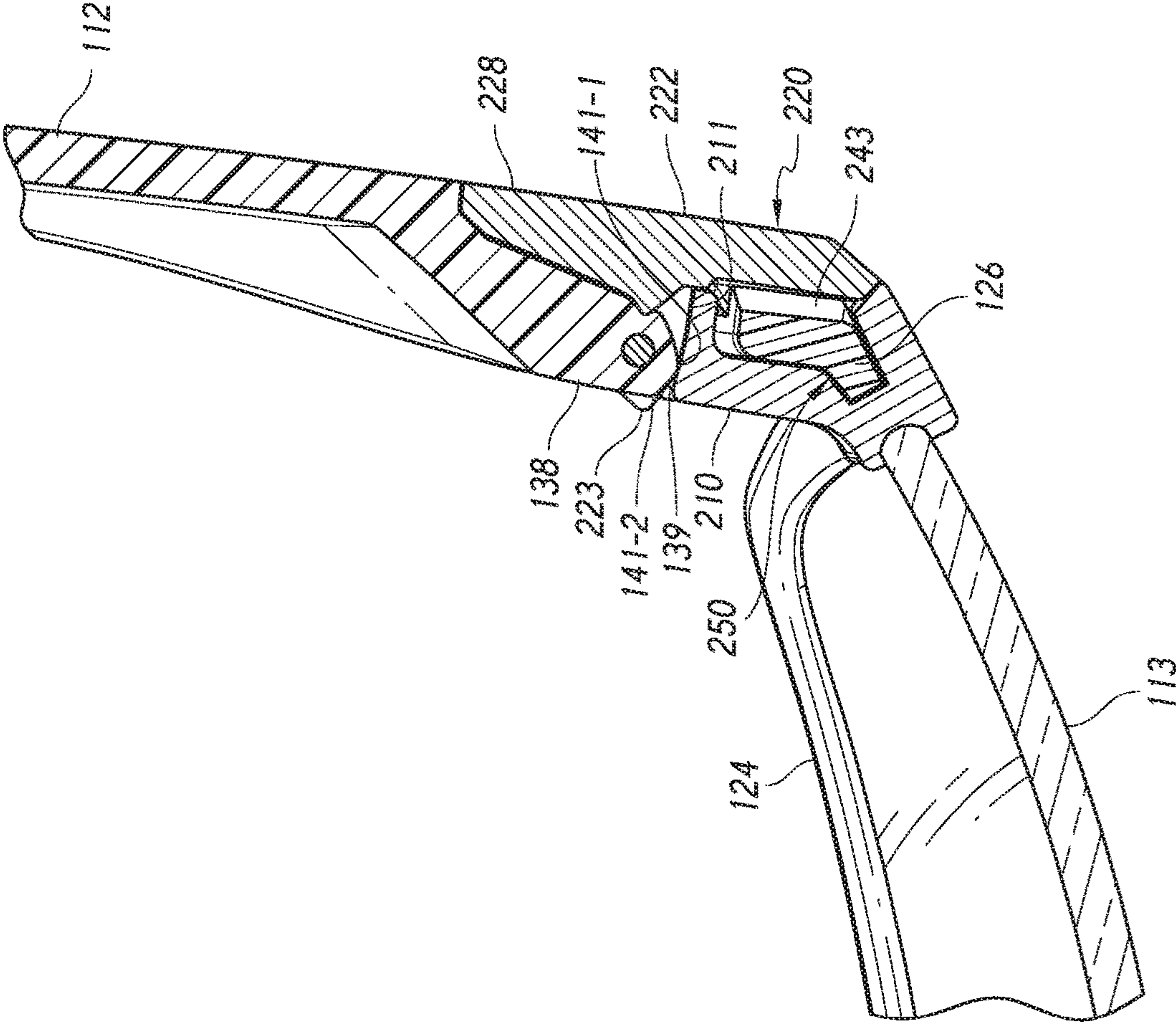


FIG. 8A

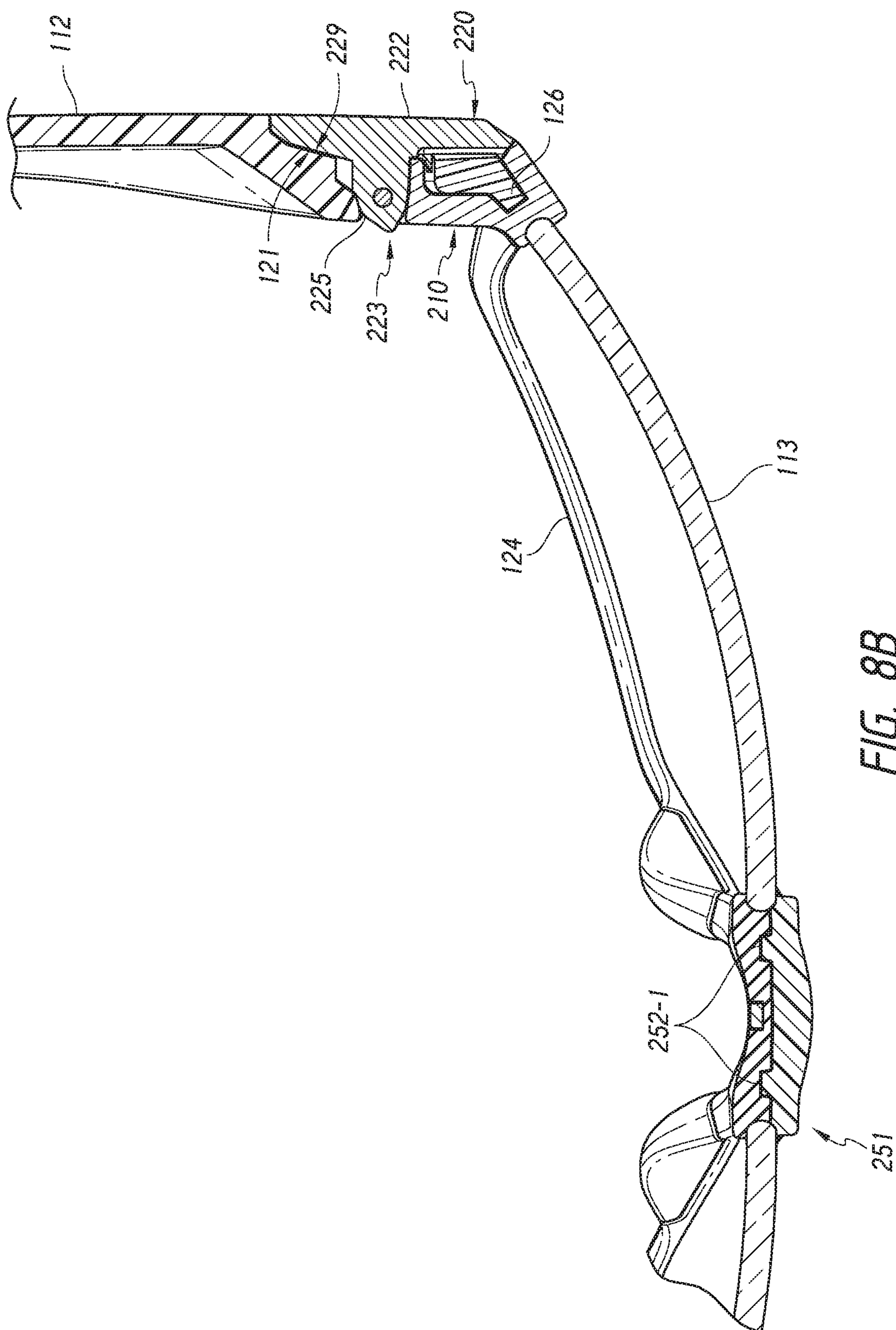
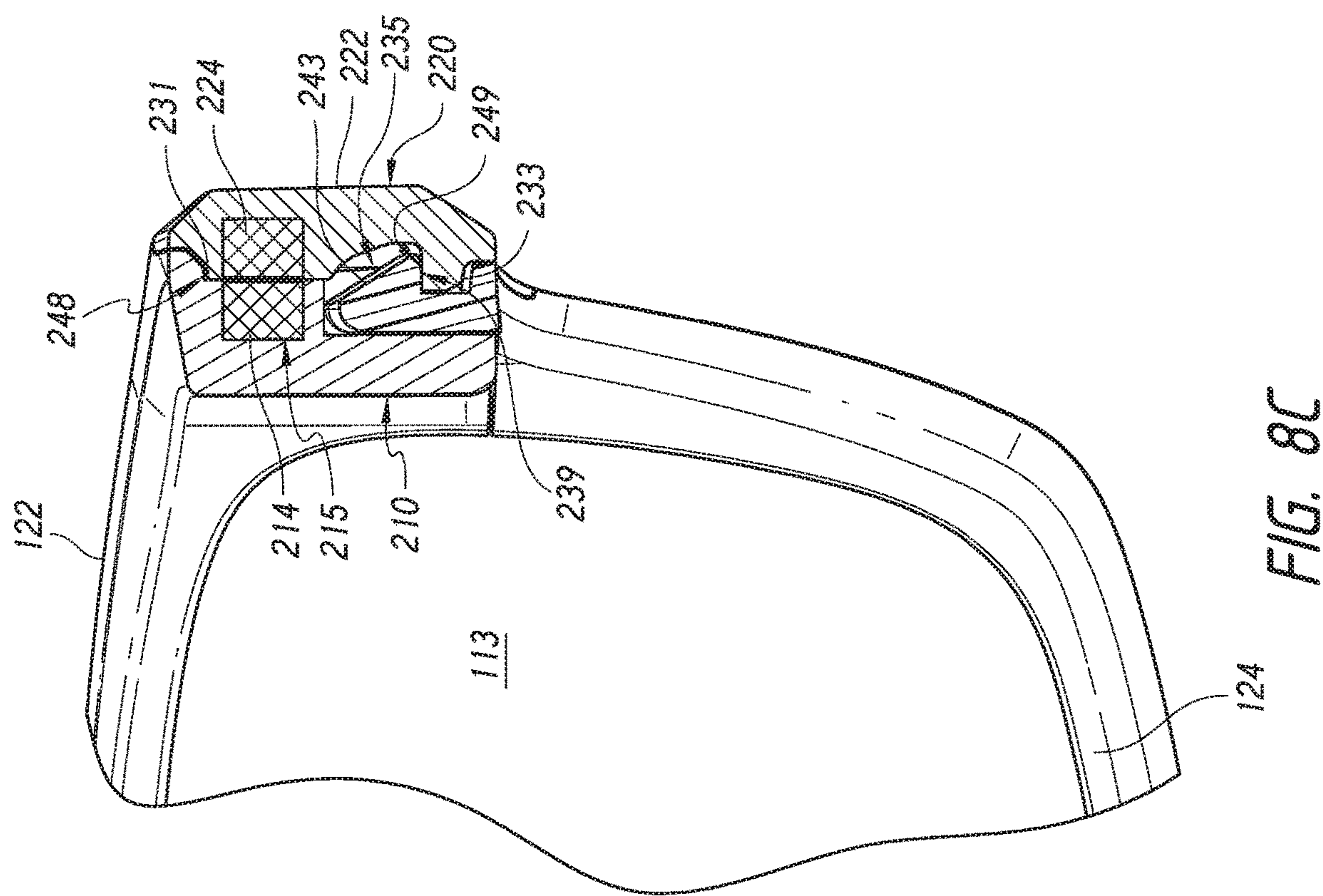


FIG. 8B



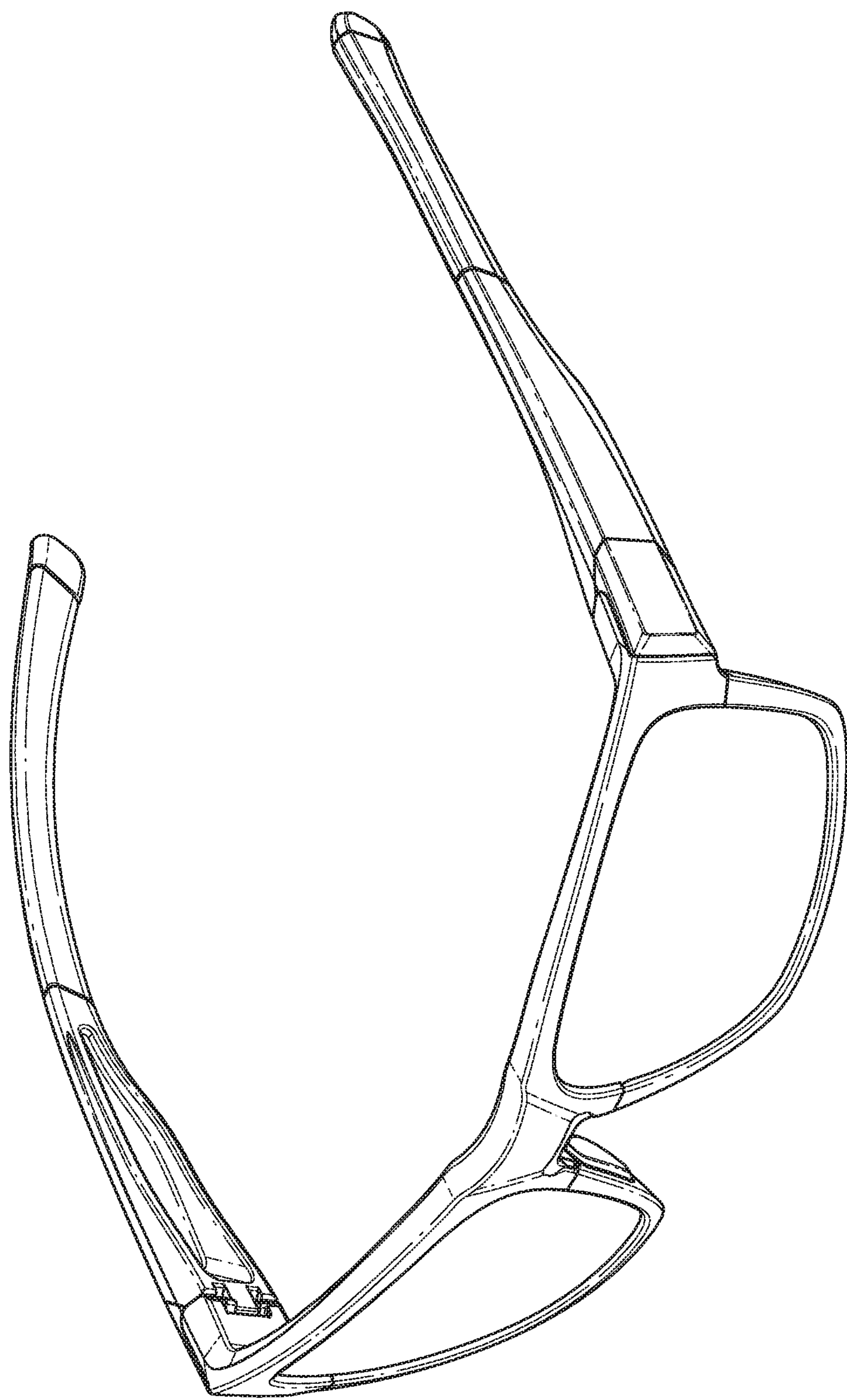


FIG. 9

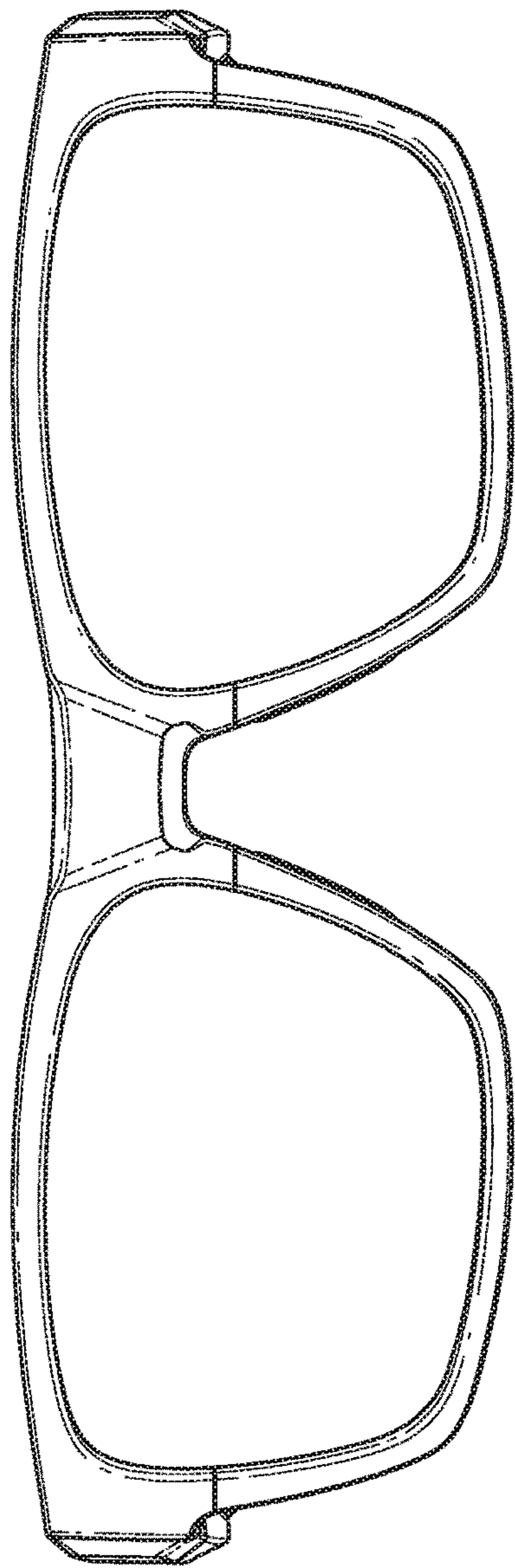


FIG. 10

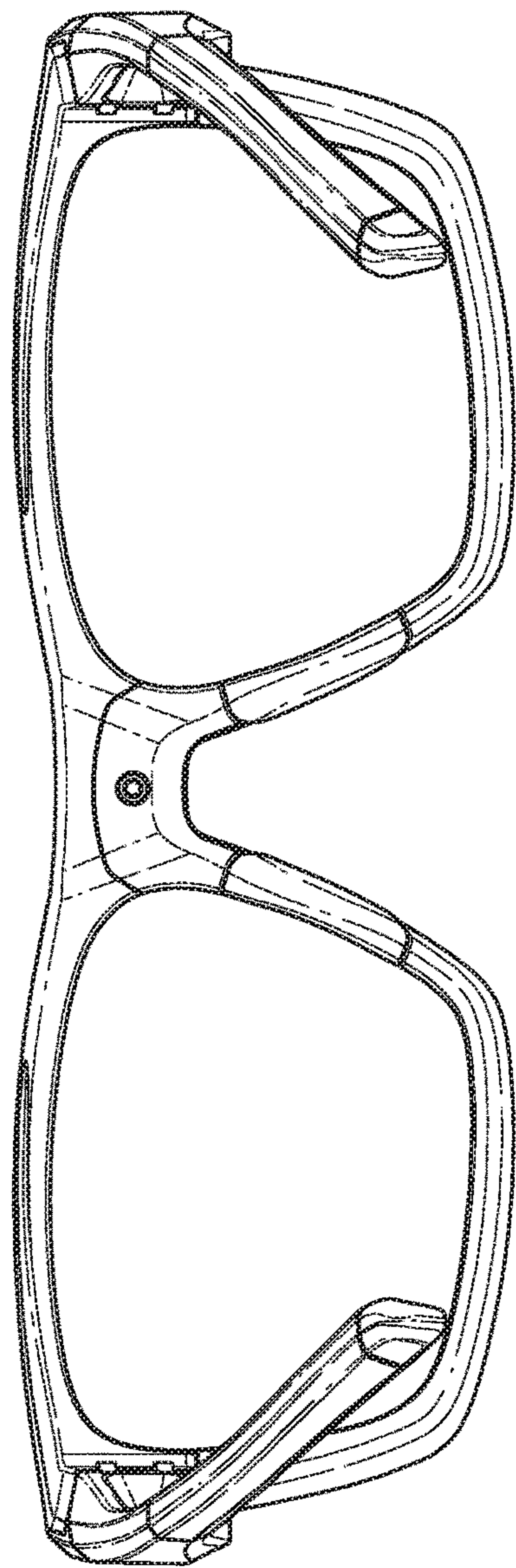


FIG. 11

FIG. 12

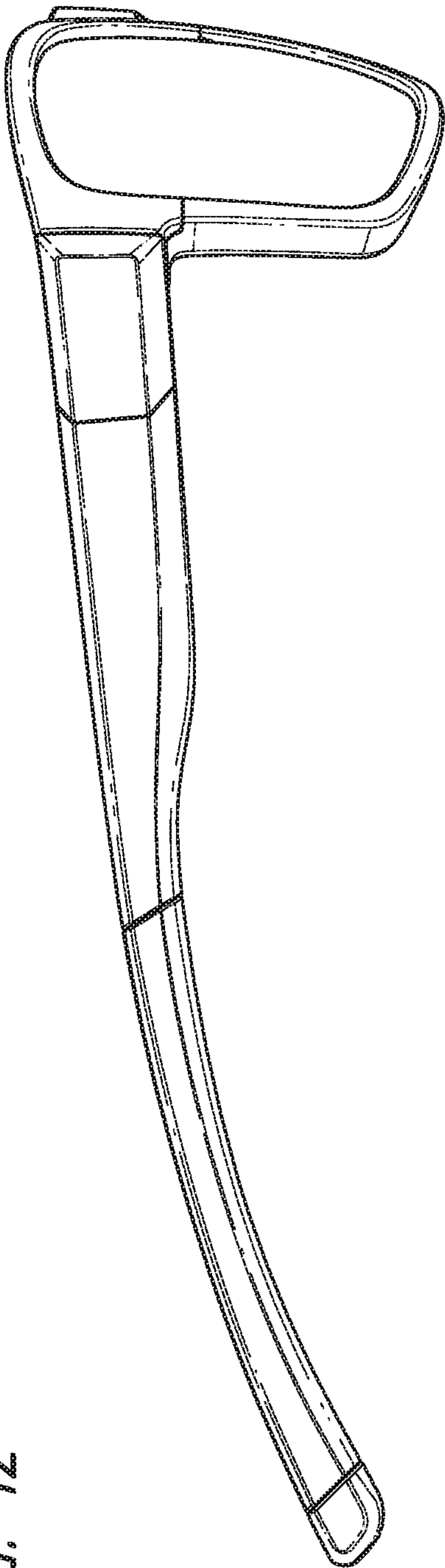
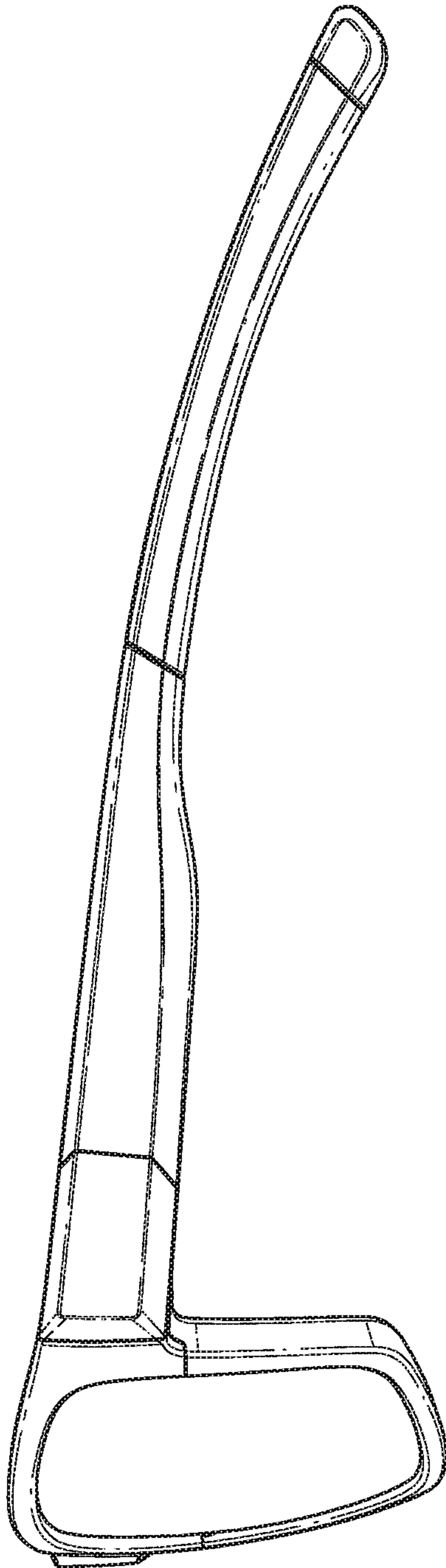


FIG. 13



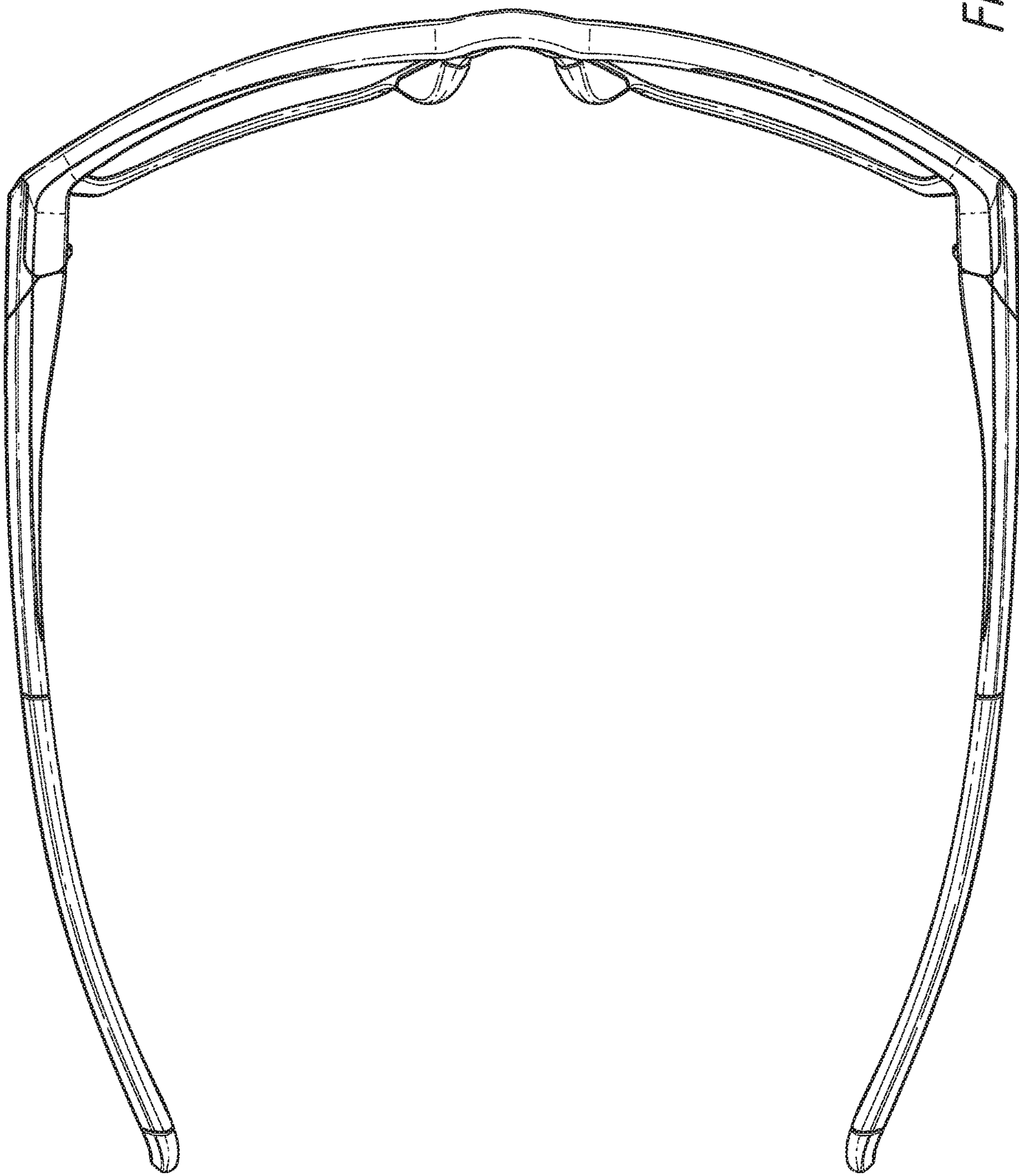


FIG. 14

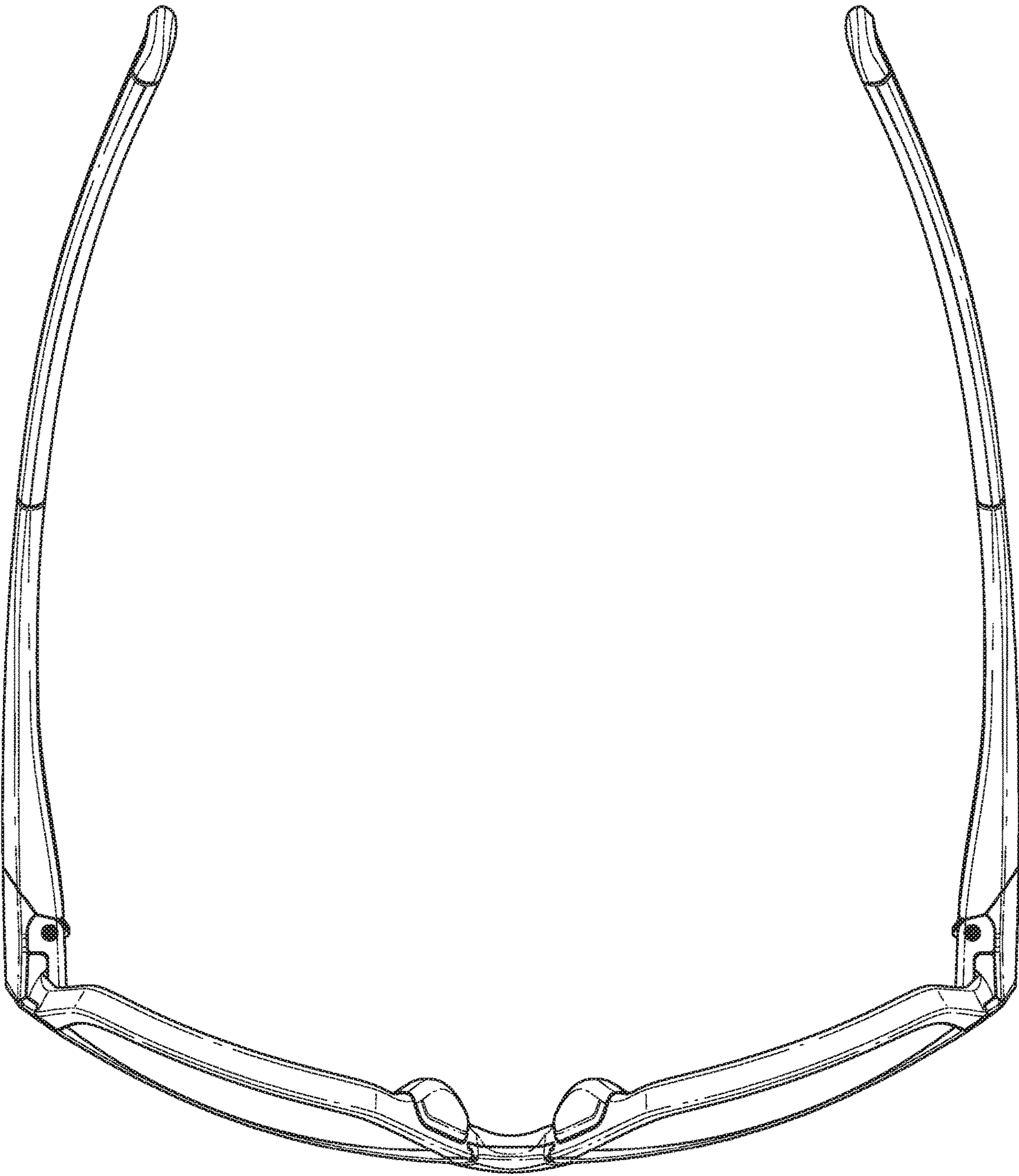


FIG. 15

1

EYEWEAR LENS INTERCHANGE WITH
MAGNETIC LATCHCROSS-REFERENCE TO RELATED
APPLICATION(S)

This application claims priority to U.S. Provisional Application No. 62/812,139 filed Feb. 28, 2019, which is incorporated herein by reference, in its entirety, for any purpose.

BACKGROUND

Eyewear with interchangeable lenses have been developed to allow a user to easily interchange the lens(es) of the eyewear, such as for aesthetic (e.g., by selecting between differently colored or tinted lenses) and/or functional reasons (e.g., to respond to different light conditions). Eyewear with interchangeable lenses typically include a mechanism to allow the user to remove the currently installed lens and replace it with another lens. In some cases, the lens may be specifically configured for use with a specific eyewear frame, such as by having engagement features (e.g., slots, apertures, or other) configured to engage cooperating engagement features on the frame. This can increase the cost for manufacturing, as the lenses may need to be specifically tailored for the given frame. In other cases, such as when a substantially encircling eyewire retains the lens in place without the need for engagement features on the lens, the lens interchange may be more cumbersome, in some cases requiring additional tools for decoupling and reassembling the lens to the eyewire. Thus, designers and manufacturers of eyewear continue to seek improvements thereto, e.g., to improve the user experience.

BRIEF DESCRIPTION OF THE DRAWINGS

This description will be more fully understood with reference to the following figures in which components may not be drawn to scale, which are presented as various embodiments of the eyewear and eyewear components described herein and should not be construed as a complete depiction of the scope of the present disclosure.

FIG. 1 is an isometric view of an eyewear with a lens interchange system in accordance with some examples of the present disclosure.

FIG. 2 is a top view of the eyewear in FIG. 1.

FIG. 3 is an exploded view of the eyewear in FIG. 1.

FIG. 4A is another isometric view of the eyewear of FIG. 1 with at least one of the temples in a partially folded position to release the latch mechanism.

FIG. 4B is another isometric similar to the view in FIG. 4A but with the separation between the eyewire portions enlarged to facilitate removal of the lens.

FIG. 5 is an enlarged partial view of the eyewear a portion of the eyewear in FIG. 4A.

FIG. 6 is another partial view of a portion of the eyewear in FIG. 4A showing the latch door exploded away from the eyewear frame to illustrate components thereof.

FIG. 7 is yet another isometric view of the eyewear in FIG. 4A illustrating a re-latching of the eyewire.

FIG. 8A is a cross-sectional view of a portion of the eyewear taken at line 8A-8A in FIG. 1 and showing components of the latch mechanism.

FIG. 8B is another cross-sectional view of a portion of the eyewear taken at line 8B-8B in FIG. 2 and showing components of the latch mechanism.

2

FIG. 8C is another cross-sectional view of a portion of the eyewear taken at line 8C-8C in FIG. 2 and showing components of the latch mechanism.

FIG. 9 is another isometric view of an eyewear according to the present disclosure.

FIG. 10 is a front view of the eyewear in FIG. 9.

FIG. 11 is a rear view of the eyewear in FIG. 9.

FIG. 12 is a left side view of the eyewear in FIG. 9.

FIG. 13 is a right side view of the eyewear in FIG. 9.

FIG. 14 is a top view the eyewear in FIG. 9.

FIG. 15 is a bottom view of the eyewear in FIG. 9.

DETAILED DESCRIPTION

Examples of eyewear with removable lenses are described. In some examples, the eyewear may comprise a lens interchange system with a magnetic latch. The lens interchange system may include a first magnetic portion fixed to the frame and a second magnetic portion pivotally coupled to the frame such that the first and second magnetic portions are operable to latch and release a portion of the lens frame to enable the interchange of a lens therein, as described further below. Eyewear according to the present application may be configured as sunglasses or other type of protective eyewear (e.g., for protection in sports, industrial settings, and/or providing ballistic protection), as prescription eyewear or a combination thereof. For example, in some instances, the lens(es) of the eyewear may be configured to provide eye protection (e.g., when engaging in a sport and/or industry), a prescription, and may be further provided with a tint, mirror coating, UV protection, and/or any other suitable compound or coating, e.g., for sun protection and/or aesthetics.

FIGS. 1-8 show views of an eyewear according to the present disclosure. The eyewear 100 in FIGS. 1-8 includes a frame 110 and two lenses 113. In this particular example, the eyewear 100 is of a dual-lens design and thus left and right lens components are provided for placement in front of the left and right eye, respectively, of the user. In other examples, the eyewear may be of the unitary lens configuration where a unitary lens or shield extends across the field of view, or at least a portion thereof, of both of the user's eyes. Additionally and optionally, the lens assembly, whether of a unitary or dual-lens configuration, may include multiple (e.g., two) individual lenses (e.g., an inner and outer lenses spaced apart from one another by an interstitial lens space). Each individual lens may have any suitable properties for a given application. For example, the lens 113 may be shaped or otherwise configured to provide power correction. The lens 113 may include a color (or tint), polarization, mirror coating, anti-reflective, anti-scratch, anti-shatter, and any other suitable treatment as may be appropriate for a given application. In some examples. In examples, the lens may be made from polycarbonate (PC), acrylic, or other suitable material(s) to provide the appropriate optical qualities (e.g., optical clarity, power correction, if any) and meet the other functional requirements of the lens (e.g., ballistic protection, sun protection, etc.). The frame 110 or components thereof may be formed of any suitable material and process. The frame 110 or components thereof may be made from an injection moldable plastic, such as Acrylonitrile Butadiene Styrene (ABS), an ABS/PC blend, High Density Polyethylene (HDPE), Thermoplastic Polyester Resin (PET), nylon, and others. The frame 110 or components thereof may be stamped, die-cut, or produced via a lamination process (e.g., from sheets of cellulose acetate). In yet other examples, the frame 110 or components

3

thereof may be formed using any other suitable forming process or combinations thereof.

The frame **110** includes lens frame or eyewire **114**, which is configured to retain the one or more lenses **113** in front of the user's eyes when the eyewear **100** is worn by the user. In the example in FIGS. 1-8, the eyewire **114** includes first and second individual lens retention portions, each defining a respective lens opening **115**, for each of the lenses **113**. In other examples, a common or shared lens retention portion may retain a single or each of the pair of lenses in place.

As shown e.g., in FIGS. 3 and 4, the lens retention portion(s) of the eyewire **114** may include lens retention feature(s). For example, a groove **116** may be formed on the lens opening side of the eyewire **114**. The groove may extend along the full perimeter of the lens opening **115**, or a portion thereof, and may be sized to receive at least a portion of the perimeter of the lens **113**. When the lens **113** is at least partially captured by the eyewire (e.g., as shown in FIG. 4A), at least a portion of the perimeter of the lens **113** may be seated in the groove **116**.

The eyewire **114** may include a first eyewire portion **122**, in this case an upper eyewire **122**, and a second eyewire portion **124**, in this case a lower eyewire **124**. The first and second eyewire portions **122** and **124** are operatively coupled to one another to define the first and second lens retention portions for retaining the lens or lenses **113** within the lens opening **115** when the eyewire **114** is in the closed configuration. The eyewire **114** is configured to define at least one gap **119** (see e.g., FIG. 4A) between portions of the eyewire **114** (e.g., between the upper and lower eyewires **122** and **124**) which is enlargeable, such as during normal operation of the latch mechanism described herein (see e.g., FIGS. 4A and 4B), to enable removal and/or replacement of one or both of the lenses **113**. During normal use, when the latch mechanism is released (unlatched or unlocked), the portions of the eyewear **114** (e.g., the upper and lower eyewires **122** and **124**) may be spreadable to enlarge the gap **119** and enable removal and/or insertion of a lens **113** within the lens opening **115**. The eyewire **114** may be closed (e.g., re-latched) to reduce or substantially eliminate the gap **119** between the first and second eyewire portions **122** and **124**, e.g., for retaining the one or more lenses **113** therebetween. The separation in the eyewire that defines the gap **119** may be provided at a location different from the hinge, such that separating of the first eyewire portion **122** from the second eyewire portion **124**, e.g., to enlarge the gap **119**, does not affect the operation of the hinge(s) **117** between the eyewire and the temple(s) **112**. Operation of the eyewire closure mechanism (also referred to as latch mechanism) does not involve, cause or require disassembly (e.g., the removal of component(s)) of the hinge **117**, whereby the hinge(s) **117** remain operational (e.g., for folding and unfolding the temples of the eyewear) in any (e.g., open or unlatched and closed or latched) state of the closure mechanism.

The eyewire **114** may be operatively associated with at least one eyewire closure mechanism (also referred to as latch mechanism), which in this example is implemented as a magnetic latch **200**. The magnetic latch **200** is configured to latch or retain the eyewire **114** in the closed configuration in which the eyewire **114** is closed (e.g., the gap **119** is substantially reduced or eliminated). The magnetic latch **200** is further configured to enable easy re-opening of the eyewire **114** for easy and quick lens interchange (e.g., without the use of any specialized equipment or tools). The closure mechanism (e.g., magnetic latch **200**) of the example in FIG. 1 is provided proximate to the temple **112** of the eyewear **100**, allowing for a gap **119** to be formed and closed

4

at a location near the temple, without affecting the proper operation of the temple hinge. In other examples, a gap in the eyewire **114** and corresponding a closure mechanism may be located elsewhere, such as at a different suitable location along the perimeter of the eyewire **114**. For example, the free end of the eyewire portion that separates may be located above the proximal end of the magnetic latch **200** and in some such embodiments, the first and second portions may instead be described as a central, or proximal, eyewire portion and an external, or distal, eyewire portion.

In some embodiments, the eyewear **100** may include a pair of temples **112**, which in the example in FIG. 1 are pivotally coupled to the eyewire **114**. In other examples, the temples may be fixed to the eyewire or the eyewear may not include temples but may instead use a different mechanism for positioning and securing the eyewire and lens(es) in front of the user's eyes (e.g., using a strap). The temples **112** may have any suitable shape and/or configuration for resting and/or securing the eyewear to the user. For example, the temples **112** may be implemented as generally elongate stem portions, which may, in some cases, curve downward (to fit around a user's ears) and/or curve inwardly toward one another (to wrap around the user's head). In some examples, the eyewear **100** may include fit enhancement features, such as temple fit features **118**. The temple fit features may include, for example, rubberized temple pads or other suitable treatment on at least a portion of the temple to improve the fit, comfort, and traction between the temples and user's head, and/or for aesthetics. The eyewear **100** may include fit enhancement features, such as nose recess fit features **129**, which may be implemented, e.g., a fixed or removable rubberized and/or adjustable nose pads for improving the fit, comfort, and/or traction of the eyewear at the nose recess **128**, and/or for aesthetics.

As further illustrated in FIG. 2, each of the temples **112** of the eyewear **100** is pivotally coupled to the eyewire **114** via a respective temple hinge **117** such that each of the temples **112** is foldable between an as-worn position **101-1** and a storage position **101-2**. The temples **112** may be foldable, during normal use such as during operation of the magnetic latch **200**, to any number of intermediate positions between the as-worn position **101-1** and storage position **101-2** including to one or more partially folded positions (e.g., latch release position **101-3**). The temple hinge **117** may include one or more detents configured to automatically position and hold, by a slight resistance to rotation of the hinge, the temples at any of the rotational positions of the temple. For example, the temple hinge **117** may be configured to detent the temple to the unfolded (or as-worn) position, to a fully folded (or storage) position, and to one or more partially folded positions such as to a latch release position. The latter may improve the ease with which the user is able to provide the temple in the latch release position and may further facilitate holding the temple in that position as the user manipulates the latch. The detents may be implemented using any suitable mechanism, such as using over-center structures (e.g., a bi- or tri-stability mechanism) operatively arranged around the rotational range of the hinge, or other suitable structures configured to resist the rotation of the temple hinge or bias the hinge to a particular rotational position. In some examples, the unfolded and fully folded positions may be achieved by hard stops, which limit the rotation of the temple hinge to between the unfolded and fully folded position. In some examples, a detent, such as a detent to a partially folded position, may be implemented by a flattened surface between two over-center positions. For example, and referring to FIG. 8A, instead of using a

5

substantially cylindrical hinge barrel, the temple hinge knuckle **138** may include a flattened portion **139** between two radially spaced-apart over center points around the perimeter of the hinge knuckle **138**. Each over center point, when interacting with the opposing surface **211** of the frame, may function as an unstable point or location on the hinge knuckle, urging the temple **112** into a rotational position on either side of the unstable point. When the temple **112** is folded back to a position in which the flattened portion **139** abuts the opposing surface **211**, the flattened portion **139** may provide a rotationally stable position of the temple **112** and thus function as a detent in the rotation of the temple **112**. The unfolded (or as-worn) and fully folded (or storage) position detents may be located on the opposite sides of the respective over-center point from the intermediate detent provided by the flattened portion.

With further reference now to FIGS. 3-6, the magnetic latch **200** includes a first magnetic portion **210**, which is fixed to the frame **110** and may thus be also referred to herein as frame magnetic portion **210**. In this example, the first magnetic portion **210** is fixed to the upper eyewire **122**. By fixed, it is implied that the frame magnetic portion **210** is rigidly attached to the upper eyewire **122**, e.g., by being monolithically or integrally formed with the upper eyewire **122** or otherwise rigidly attached by any suitable means such as mechanical fasteners, glue or others that are currently known or later developed. Depending on the desired overall shape of the eyewear **100**, the first magnetic portion **210** may be part of or fixed to a portion of the frame **110** that extends at an angle to the arc direction of the lens frame **110**, as in the example in FIG. 2. In other examples, the frame and temples may define a generally arcuate shape and the first magnetic portion **210** may be part of or fixed to a portion of the frame **110** that extends substantially along the arc of the lens frame.

The magnetic latch **200** further includes a second magnetic portion **220** pivotally coupled to the frame **110**. Each of the first and second magnetic portions **210** and **220**, respectively, includes a respective magnetic element **214** and **224**. The first and second magnetic elements **214** and **224** may be positioned on the first and second magnetic portions **210** and **220**, respectively, to attract one another and urge the second magnetic portion **220** toward the first magnetic portion **210** and thus toward the closed position of the latch **200**. In some embodiments, the first and second magnetic elements **214** and **224** may be configured to contact when the latch **200** is closed. In other embodiments, the first and second magnetic elements **214** and **224** may be differently arranged, e.g., one or both may be embedded and/or below the facing surfaces of the first and second magnetic portions such that they do not contact one another as long as the magnetic elements **214** and **224** are configured to provide sufficient magnetic attraction to close the latch **200**. In yet other embodiments, one or both of the magnetic elements **214** and **224** may be exposed but spaced apart from one another in the closed position such that the two magnetic elements do not touch, when the latch is closed. The latter arrangement may avoid marring of the exposed surface of the magnetic elements and/or reduce the risk of the magnetic elements becoming dislodged through repeated contact. Any suitable arrangement of the first and second magnetic elements, including using a plurality of magnetic elements for each of the magnetic elements **214** and **224**, to provide sufficient magnetic attraction to close the latch **200** may be used.

The first magnetic element **214** is fixed to the first magnetic portion **210**. For example, the first magnetic por-

6

tion **210** may include a first magnet seat **215**, which is sized to receive the first magnetic element **214** therein. The magnet seat **215** may be configured such that the first magnetic element **214** is substantially flush with the surface of the first magnetic portion **210** that faces the second magnetic portion **220**. In other examples, the first magnetic element **214** may be arranged to protrude above the facing surface of the first magnetic portion **210**. In yet other examples, the first magnetic element **214** may be embedded in the first magnetic portion **210** such that the first magnetic element is not exposed. Any other suitable arrangement of the first magnetic element **214** on the first magnetic portion **210** that enables the first magnetic element **214** to attract the second magnetic portion **220** may be used in other examples.

The magnetic elements **214** and **224** may be implemented using magnets (e.g., permanent magnets such as neodymium magnets) for both the first and second magnetic elements **214** and **224**, or they may be implemented using a pairing of one or more magnets associated with either the first or second magnetic portion and a ferromagnetic material (e.g., steel or other ferromagnetic metal) on the other one of the two magnetic portions. The use of two magnets in some embodiments may provide additional centering function (e.g., resulting from the magnets' natural tendency to axially align their respective fields to one another), which may enhance the alignment and a tighter closure or fit of the second magnetic portion **220** to the frame **110**. In some embodiments, the alignment and tighter fit may be further enhanced by contouring features of the magnetic latch **200**. For example, the first magnetic portion **210** may include a depression **248** and the first magnet seat **215** may be located in the depression **248**, as shown also in FIG. 8C. The second magnetic portion **220** may be provided with a mound **231**, which defines the seat for the second magnetic element **224**. The depression **248** may be sized for a cooperating fit with the mound **231** and be therefore configured to receive the mound **231**, at least partially, therein. The depression **248** may abut surfaces of the mound **231** around at least a portion of the perimeter of the mound **231** thereby aiding in the positioning of the mound **231**, and thus the second magnetic portion **220**, with respect to the frame **110** when the latch **200** is closed.

The second magnetic portion **220** may be implemented as a pivotal component (referred to as latch door **222** in the context of the present example), which carries the second magnetic element **224**. The latch door **222** is pivotally coupled to the frame **110** such that the latch door **220** can be opened responsive to the application of an actuation force (FA), which may be manually applied, and closed (e.g., automatically) responsive to the magnetic attraction between the first and second magnetic portions **210** and **220**. When the eyewear is in the as-worn configuration, the latch door **222** is maintained in the closed position as result of the magnetic attraction between the first and second magnetic portions **210** and **220**. Additionally and optionally, when the eyewear is in the as-worn configuration, the latch door **222** may be locked into the closed position by a lock out mechanism, described further below.

In some embodiments, as in the example in FIG. 3, the pivot axis of the latch door **220** may coincide with the temple hinge axis X. Using a common pivot axis between the latch door and the hinge may provide a more compact design of the lens interchange mechanism. It is contemplated however, that in other embodiments, the temples and latch door may pivot at different axes while still provide the features and functionality described herein. For example, the pivot axis for the latch door may be substantially parallel to

the hinge axis X by offset from the hinge axis X, e.g., toward the front side of the eyewear 100. In other examples, the two axes may be spaced apart and be non-parallel, non-intersecting axes (e.g., skew axes). In yet other example, the latch door may pivot about an axis that is oriented substantially horizontally such that the latch door swings up and down to open and close. Any other suitable arrangement of the pivotal component of the second magnetic portion 220 may be used as long as the first and second magnetic portions 210 and 220, respectively, are configured to magnetically attract one another such that the latch door 222 can be retained in a closed position as a result of the magnetic attraction between the first and second magnetic portions.

The magnetic latch 200 includes a latch cavity 250 configured to receive a latch catch 126. The latch cavity 250 may be defined in part by the first and second magnetic portions 210 and 220, respectively. For example, the latch cavity 250 may be provided in part by a recess 252 (see FIG. 5) formed in one of the first magnetic portion 210, e.g., below the magnet seat 215, and further in part by the latch door 222. In other examples, the recess 252 may instead be located on the latch door 222. The cavity 250 may be sized and shaped to receive the latch catch 126.

The latch catch 126 and latch door 222 are configured to engage one another to retain the eyewire 114 in the closed position when the lower eyewire 124 is in the up position (with the latch catch 126 inserted into the cavity 250, as shown in FIG. 6) and the latch door 222 is closed. To that end, the latch catch 126 and latch door 222 may include cooperating features (e.g., interlocking features), which mechanically retain the latch catch 126 to the latch door 222 thereby mechanically locking the lower eyewire 124 in the closed position when both the lower eyewire 124 is provided in the up position and the magnetic latch 200 is closed. For example, the latch catch 126 and the latch door 222 may include opposing ledges 239 and 249, respectively, which about one another thereby mechanically preventing removal of the latch catch 126 from the cavity 250 when the latch door 222 is closed. The ledge 239 may be provided by a downward facing wall on the latch catch 126, while the ledge 249 may be provided by an upward facing wall on the latch door 222. The terms upward and downward as used herein assume the eyewear is oriented as would be worn by the user and are thus arbitrary, used solely for the purpose of illustrating that the two walls or ledges face in opposite direction, and do not otherwise limit the embodiments of the invention. The upward facing wall providing the ledge 249 may be part of a structure (e.g., protrusion 226) extending from the latch door 222 toward the first magnetic portion 210. The protrusion 226 may be spaced apart from the mound 231 by a cavity 235 sized to accommodate the wedge 243 of the latch catch 126. In some examples, the cavity 235 may have a substantially similar cross-sectional geometry as the wedge 243 for a cooperating fit therewith. In other examples, the cavity 235 may loosely accommodate the wedge, with a void remaining between the wedge 243 and the walls of the cavity 235, as shown in FIG. 8C. The ledge 239 may be provided by one of the opposing walls of a channel or slot 246 formed in the latch catch 126 and configured to receive the protrusion 226.

In use, removal and installation of a lens may be easily achieved by operation of the closure mechanism (e.g., magnetic latch 200) of the present disclosure without the use of any specialized equipment or tools. To remove the lens 113, the temple 112 may be folded, at least partially, towards the storage position. For example, as shown in FIG. 2, the temple may be provided into the latch release position 101-3

to expose the lever portion 228 of the latch door 222. In some embodiments, when the temple 112 is so folded into a latch release position, rotation of the temple 112 out of that position may be resisted by a temple hinge detent such that the user need not hold the temple 112 into the latch release position while operating the latch mechanism. An actuation force FA may be applied by the user to the now exposed lever portion 228 of the latch door 222, as shown in FIG. 2. The lever portion 228 extends in an opposite direction from the pivot or fulcrum of the latch door 222 than the portion of the latch door, which supports the second magnetic element 224. Thus, the application of an actuation force to the lever portion 228 causes the latch door to pivot about its fulcrum causing the first and second magnetic portions 210 and 220 to separate against the magnetic attraction between the first and second magnetic elements 214 and 224 thereby providing the latch 200 into the open configuration (e.g., see FIG. 4A), which consequently causes the eyewire to open (i.e., the free end of the lower eyewire, which carries the latch catch decouples or separates from the upper eyewire).

The eyewire 114 may be preloaded to spring to a partially open configuration (e.g., as shown in FIG. 4A) when the latch is released. In some examples, the eyewire 114, or at least a portion thereof, may be formed of a material that returns to a nominal unloaded state. For example, the eyewire 114 or a portion thereof (e.g., the lower eyewire 124) may be formed of a plastic material into the shape corresponding to the partially open configuration of the eyewire, such that when no force is being applied to the lower eyewire (e.g., to hold it closed via the latch), the lower eyewire may naturally return to the partially open configuration. In other examples, the eyewire or portion thereof, which is preloaded to the partially open configuration may be formed of a different suitable material (e.g., a metal, a composite, or others). The preload (or spring bias) in the eyewire 114 may be sufficiently high to allow the eyewire 114 to spring open to a partially open configuration, in which the latch catch 126 is released (e.g., not mechanically locked in and at least partially removed from the latch cavity). The preload (or spring bias) may be sufficiently low such upon release of the latch 200, the lens 113 may remain at least partially captured in the lens opening 115 to prevent the lens 113 from falling out of the frame 110 until the user further enlarges the lens opening 115 (e.g., as shown in FIG. 4B) and/or manually removes the lens 113 from the frame 110. In examples herein, the opening of the eyewire 114 (e.g., the enlarging of the gap 119 to facilitate removal and installation of a lens) may be achieved through elastic deformation of the eyewire 114, e.g., in this example by elastically deforming the lower eyewire 124 away from the upper eyewire 122.

As illustrated in FIG. B, once the latch catch 126 has been released, the gap 119 and correspondingly the lens opening 115 may be further enlarged such as by manipulating the free end of the lower eyewire 124 away from the latch mechanism 200 (e.g., in the direction 103) until the lens 113 can be removed from the frame 110 and/or to enlarge the opening 115 for insertion of a lens 113 therein. Once the latch catch 126 has been released from the latch, the user may remove the force from the lever and thus release the latch door to close. Magnetic attraction between the latch door 222 and the frame magnetic portion 210 may simplify the operation of the latch 200 in that the latch door 222 need not be manually opened and close when re-installing or re-latching the lower eyewire 124. Once the latch door 222 has been released and allowed to return to the closed position, to re-latch the eyewire 114, the user simply applies

a squeezing force on the top and bottom of the eyewire to force the lower eyewire **124** into the closed position.

To install a lens to the frame **110**, a lens **113** may be placed in the lens opening such as aligning the lens with and inserting a perimeter portion of the lens into at least a portion of the groove(s) **116**. For example, the user may align and insert the upper perimeter of the lens **113** into the groove **116** of the upper eyewire **122**, as shown in FIG. 7. Once so positioned, the latch catch **126** may be aligned with the opening of the latch cavity **250** and a squeezing force F_s may be applied to the top and bottom of the eyewire **114**, e.g., as shown in FIG. 7, to cause the latch catch **126** to move in a general upward direction **105** and be inserted into the latch cavity **250**. The squeezing force F_s may be applied by applying a force to the top eyewire while concurrently applying a counter force to the bottom eyewire. The force and counter force may be applied to respective portions of the upper and lower eyewire such that the forces act through a line that passes through or is as close as possible to the latch cavity, which may reduce the moment and thus distortion on the frame during the automatic re-latching of the closure mechanism. The application of the force F_s may cause the first and second magnetic portions **210** and **220** to automatically temporarily separate to allow the latch catch **126** to be inserted into the cavity **250**, the latch **200** being configured to automatically close, after the latch catch **126** has been inserted into the cavity **250**, responsive to the magnetic attraction of the first and second magnetic portions **210** and **220**. In this example, the operation (e.g., opening and closing) of the latch door **222** is independent of the position of the lower eyewire **124** and latch catch **126**, and thus closing of the latch door **222** does not necessarily result in closing of the eyewire **114** unless the latch catch **126** is operatively positioned within the latch cavity **250**. In other words, the latch door **222** is operable to close via magnetic attraction even if the latch catch **126** is not engaged and the lens opening **115** is in the gapped configuration. The absence of the latch catch from the latch cavity does not prevent closing of the latch door.

To facilitate the automatic temporary opening of the latch **200** (i.e. without manually separating the magnetic portions) during re-latching of the eyewire **114**, the magnetic latch **200** may be provided with at least one ramp that assists with the temporary opening of the latch. The ramp may be located either on a surface of the latch cavity **250** or on the free end of the separable eyewire (e.g., the lower eyewire **124**). In the illustrated example (e.g., in FIG. 5), the at least one ramp is provided on the free end of the separable eyewire, such as by shaping a leading portion of the latch catch **126** as a wedge **243**. The inclined leading surface of the wedge **243** may cooperate with the latch door **222** to temporarily open the latch door **222** during insertion of the latch catch **126** within the latch cavity **250**. In other embodiments, the ramp may be located elsewhere, for example on the latch door itself and/or on the wall of the latch cavity opposite the latch door. In embodiments in which the ramp is provided by the latch cavity, the free end of the separable eyewire may be wedge shaped or it may be blunt. In some embodiments, a plurality of cooperating ramps may be used. For example, a ramp (e.g., in the form of a wedge) may be provided on the latch catch, which cooperates with a ramp **233** on the latch door **222** (or on the opposite wall of the latch cavity) to push on the latch door **222**, temporarily separating the magnetic elements **214** and **224** to allow the latch catch **126** to slide into the cavity **250**. Once the latch catch **126** has been operatively inserted into the cavity **250**, in this case with the protrusion **226** of the latch door **222** received in the coop-

erating slot **246** of the latch catch, the latch **200** automatically returns to the closed position by the magnetic attraction of the first and second magnetic elements **214** and **224**. In some embodiments, the incline of the leading surface of the wedge **243** may be about 45 degrees, or in the range of about 30 degrees to about 55 degrees. In some embodiments, the incline may be shallower than 30 degrees or steeper than 55 degrees as long as there is sufficient inclination to enable the leading portion of the latch catch **126** to act as a wedge to separate the first and second magnetic portions **210** and **220** as the latch catch moves into the cavity **250**.

In some embodiments, the closure mechanism may be provided with a lock out feature. For example, the magnetic latch **200** may be configured such that a locking feature **120** operatively engages the lever **228** when the temple **112** is in the unfolded or as-worn position to prevent pivoting of the latch door **222** and thus prevent separation of the first and second magnetic portions **210** and **220**. In an example in which the latch door is pivotally coupled to the frame at the temple hinge, the locking feature **120** may be provided by a lock out surface **121** of the temple (see e.g., FIG. 3). Referring to the example in FIG. 8C, a portion of the lever **228** (e., surface **229**) may be configured to engage (e.g., abut) a portion of the temple **112** (e.g., locking surface **121**), such that rotation of the latch door **222** is prevented when the temple **112** is in the as-worn position. In other examples, the lock out feature may be differently implemented, such as by using other suitable blocking surfaces positioned differently on the temple, latch door, or other portions of the frame.

In some examples, the rotation of the latch door **222** may be limited, for example by a hard stop **223**. The hard stop **223** may be implemented as a protrusion on the outward surface of the latch door knuckle **225**. The protrusion **223** may extend radially outward from a nominal cylindrical profile of the outward surface of the hinge knuckle **225** (indicated in broken line in FIG. 8B) by a sufficient amount to prevent rotation of the latch door beyond the location of the protrusion **223**. Limiting rotation of the latch door **222** to an amount, less than the full rotational range of the temple may maintain the two magnetic portions **210** and **220** in magnetic attraction range thus enabling the latch door to automatically return to closed position by magnetic attraction rather than requiring manual closing of the latch door. In other words, a hard stop may be used to limit the separation of the two magnetic portions to a distance within which sufficient magnetic attraction is exerted between the two magnetic elements to automatically return the latch door to the closed position upon release of the manual opening force.

For ease of manufacturability, the eyewire **114** may be formed, in some examples, as two or more separate components that are assembled to provide the eyewear in FIG. 1. For example, the upper eyewire **122** and the lower eyewire **124** may be manufactured (e.g., injection molded or laminated) separately and the two eyewire components may be rigidly coupled to one another to form the eyewire **114**. In the present example, the upper eyewire **122** is joined to the lower eyewire **124** at the nose recess, however in other examples the eyewire portions may be joined at different suitable location(s). In yet other examples, with the exception of the seam at the closure mechanism, the eyewire may be substantially seamless (e.g., when manufactured as a single component). In the present example, the upper and lower eyewires are joined by a lap joint **251** at the nose recess **128**, which is further reinforced by tongue and groove features **254-1** and **254-2** in the direction of the lap joint and tongue and groove features **252-1** (see FIG. 8B) and **252-2**

11

in the thickness direction of the lap joint. Any other suitable joint may be used. Additionally or alternatively, the upper and lower eyewire may be joined by any other suitable means, such as via mechanical fasteners 256, adhesives, laser welding, etc., currently known or later developed. While illustrating an example in which the upper and lower eyewires 122 and 124, respectively, are formed as separate components, it will be understood that in normal use the upper and lower eyewires 122 and 124 remain attached to one another but for the portion of the lower eyewire 124, which is separable to form the gap 119. In embodiments of the present disclosure, the upper and lower eyewires 122 and 1254 may be integrally formed as a single or monolithic component. The latch door 222 and the temples 112, in examples in which they are pivotally coupled to the eyewire 114, may also be assembled to the eyewire 114, e.g., by aligning the temple and latch door hinge knuckles 138 and 225, respectively, to the eyewire hinge knuckle 127 and securing a pin (e.g., a fastener) through the axially aligned openings of the hinge knuckles. In other embodiments, in which the temple and latch do not share a common pivot axis the individual pivotal joints may be separately assembled.

FIGS. 9-15 show additional views including an isometric, front, rear, left, right, top and bottom views, of an eyewear according to the present disclosure.

All relative and directional references (including: upper, lower, upward, downward, left, right, leftward, rightward, top, bottom, side, above, below, front, middle, back, vertical, horizontal, and so forth) are given by way of example to aid the reader's understanding of the particular embodiments described herein. They should not be read to be requirements or limitations, particularly as to the position, orientation, or use unless specifically set forth in the claims or is otherwise implied by the present disclosure. Those skilled in the art will appreciate that the presently disclosed embodiments teach by way of example and not by limitation. Therefore, the matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense. The following claims are intended to cover all generic and specific features described herein, as well as all statements of the scope of the present method and system, which, as a matter of language, might be said to fall there between.

What is claimed is:

1. An eyewear comprising:

- a frame comprising an eyewire configured to encircle a lens to couple the lens to the frame, the eyewire comprising a first eyewire portion and a second eyewire portion, the second eyewire portion having a free end that separates from the first eyewire portion to enable removal of the lens from the eyewire;
- a temple coupled to the eyewire and pivotable between a storage position and an as-worn position; and
- a magnetic latch comprising a magnetic latch door pivotally coupled to the eyewire and operable, when the magnetic latch door is closed, to couple the free end of the second eyewire portion to the first eyewire portion to provide the eyewire in a closed configuration in which the lens is coupled to the frame, wherein the magnetic latch defines a latch cavity, wherein the second eyewire comprises a latch catch on the free end of the second eyewire, and wherein the latch catch is configured to interlock with the latch door to close the eyewire when the latch catch is positioned in the latch cavity and the latch door is closed, the eyewear further comprising at least one ramp on at least one surface of the latch cavity, a leading portion of the free end of the

12

second eyewire, or both, wherein the ramp is configured to cause the latch door to open during insertion of the latch catch into the latch cavity.

2. The eyewear of claim 1, wherein the temple prevents the magnetic latch door from opening when the temple is in the as-worn position.

3. The eyewear of claim 1, wherein the temple remains attached to the eyewire during opening and closing of the magnetic latch.

4. The eyewear of claim 1, wherein the temple and the latch door are pivotable about a common pivot axis.

5. The eyewear of claim 1, wherein the magnetic latch includes a first magnetic portion comprising a first magnetic element fixed to the frame and wherein the magnetic latch comprises a second magnetic element fixed to the magnetic latch door, the first and second magnetic elements operatively arranged to magnetically attract the magnetic latch door toward a closed position.

6. The eyewear of claim 5, wherein the first magnetic element and the second magnetic element each comprise a magnet.

7. The eyewear of claim 5, wherein the latch door includes a protrusion configured to limit rotation of the latch door to a rotational position within a range of magnetic attraction of the first and second magnetic elements.

8. The eyewear of claim 1, wherein the ramp is provided by a wedge on the leading portion of the free end.

9. The eyewear of claim 1, wherein the eyewire is configured to spring to a partially open position upon release of the magnetic latch.

10. The eyewear of claim 9, wherein the eyewire at least partially captures the lens when the eyewire is in the partially open position.

11. The eyewear of claim 1, wherein the temple is coupled to the eyewire via a temple hinge, and wherein the temple hinge comprises a detent configured to hold the temple in a partially folded position.

12. The eyewear of claim 1, wherein the eyewire defines left and right lens openings for respective left and right lenses of the eyewear, and wherein each of the left and right lens openings is associated with a respective magnetic latch.

13. The eyewear of claim 1, wherein the frame defines a nose recess, and wherein the first and second eyewire portions are rigidly coupled via a joint located at the nose recess.

14. The eyewear of claim 1, wherein the first eyewire portion is an upper eyewire and the second eyewire portion is a lower eyewire.

15. The eyewear of claim 1, wherein the first eyewire portion extends only along a first portion of a perimeter of the lens and the second eyewire portion extends only along a second portion of the perimeter of the lens when the lens is coupled to the frame.

16. A lens-interchange method for an eyewear having a first eyewire portion and a second eyewire portion and a magnetic latch configured for latching the second eyewire portion to the first eyewire portion, the method comprising: folding a temple of the eyewear to expose a lever of the magnetic latch, the magnetic latch comprising a first magnetic portion fixed to the first eyewire portion and a second magnetic portion pivotally coupled to the first magnetic portion; applying a force to the lever to separate the first and second magnetic portions, wherein the second eyewire portion is configured to spring open upon separation of

13

the first and second magnetic portions to form a gap
between a free end of the second eyewire portion and
the first eyewire portion;
releasing the force on the lever to allow magnetic attrac-
tion to return the first and second magnetic portions to 5
the closed position;
enlarging the gap between the free end of the second
eyewire portion and the first eyewire portion to release
the lens from the eyewear; and
simultaneously applying a force and a counterforce to the 10
first eyewire portion and the second eyewire portion,
respectively, to re-engage the free end of the second
eyewire portion with a door of the magnetic latch
thereby re-latching the eyewire without manually open-
ing the magnetic latch. 15

17. The method of claim **16** further comprising locking
the magnetic latch from opening by pivoting the temple to
an as-worn position.

* * * * *

14